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BRIEFLY TOLD.

MR. HUMPHREY'S PAPER ON GAS ASSOCIATIONS AND THEIR MUTUAL RELATIONS.—Both timely and interesting was the paper on this subject, read by Mr. C. J. R. Humphreys before a recent meeting of the Society of Gas Lighting. Of course, had the paper emanated from another source, it would be just as timely and perhaps equally interesting: but coming as it does from the pen of the Secretary of the American Gas Light Association, we know that it springs from a source in every respect calculated to speak with authority.

Those who have closely noted the formation and progress of the various gas associations are agreed as to one result of this multiplication, which, briefly stated, is that the American Association's field for usefulness has been and is being curtailed. We do not wish to be understood as intimating that the American Association shows signs of decay, even while we admit that symptoms of weakness are undeniably not lacking. Apart from the feeling of local pride that must naturally act as a staunch support to the local associations, and which just as naturally must react inimically on the association that does not appeal to locality for sustenance, it must not be forgotten that the meeting of the American Association is set for a time after all the district associations have completed their labors. There is much of homely truth and reasonable justification in the reply that is often made to the Secretary's appeal for a paper for the American Association, the response being (as stated by Mr. Humphreys) thus framed: "No; I cannot write anything for the American Association, because I have to prepare an essay for the meeting of the —— Association. I cannot write two papers in one year." Nor is it to be expected that one member should offer himself up as a sacrifice with too great frequency; for it is also a fact that our American gas engineers, who would and do not quail from 12 to 14 hours of hard work out of each 24 hours, seem to dread the travail of composition. This leads to the thought that there really is no good reason why the American Association should ever lack an even lengthy paper list, because it is notoriously true that 75 per cent. of its large membership list are to be charged with never having figured as contributors in set form to the proceedings. It is all very well to be a wheel-horse, but it is all quite wrong that the same wheel-horses should be asked to do the pulling from year to year. If all are to enjoy the good work that is done, each should be willing to contribute his quota at the proper time.

However, if individual effort cannot be safely counted on, Secretary Humphreys seems to have discovered a way wherein collective work may be profitably substituted for it. It seems to us, indeed, that if his "Research Committee" plan, properly elaborated, of course, were to be given a fair trial, the value of *all* our Associations' work would be greatly enhanced. And in saying this, we are not at all unmindful of the sterling value of the records already made. On the contrary, we have a live sense of the lasting benefits that have been conferred on our calling because of their teachings and example.

The Committee plan, too, would not lessen one whit the opportunity for securing stated papers; perhaps it would aid us in obtaining them. If the observation of one man is of value—and we submit there can be no variance of opinion about this—can we not go further and say that the observation of many men would be yet more valuable.

Mr. Humphreys has so clearly and cleverly outlined the many ways in which his proposed Research Committee could be made effective, that we here have no need to again go over that ground; but having made the way clear, it is to be sincerely hoped that he will not allow the matter to go by default by reason of not returning to the charge. Not only would the fraternity be benefited technically by his proposed procedure, but we also incline to the view that the present tendency to support district associations on pleas of locality and home rule, if we may so say, would be decidedly lessened. Give to all a common interest, be it ever so slight, and the future healthy growth and continued prosperity of all our associations will be at once and permanently guaranteed.

PUBLIC LIGHTING IN NEW YORK CITY.—Since the disruption of the "combine" of some years ago, when the city of New York was obliged to pay $255.50 each per annum for arcs of doubtful candle power, we have, on the occasion of the annual opening of the bids for the city's public lighting, been treated to rather odd vagaries in the figure line by the electric bidders. This year was no exception, and the Gas Commission are now engaged in an attempt to get from the electric light suppliers proposals sufficiently intelligible for the purpose of making a contract. The awards for gas lighting for the current year—May 1, 1889, to April 30, 1890—were made on the basis of last year's rates, but the arc lighting bids were all rejected, chiefly because of the erratic action of the Mount Morris Lighting Company, whose proprietors seemed fired with a desire to secure contracts on certain streets not named in the specifications submitted to them for estimate. As intimated before, the electric bids were all rejected, and July 2d was fixed as the time for opening the new propositions. It is pretty well settled, however, that New York will not have to pay in excess of 35 cents per arc per night for the current year, and that figure is certainly ample compensation for the lighting value of the arcs maintained.

In the meantime we are pleased to report that the Siemens Lungren Company is not only keeping up the excellent sample of street illumination (on Madison avenue between 31st and 33d streets) maintained through the agency of the Company's regenerative burner of the Gordon type, but has extended the same over Fifth avenue, between 14th and 23d streets. Along this footway 27 lamps have been placed, and we tell but the simple truth when we say that this is the most effective specimen of street illumination in the city. It must be seen to be appreciated, and there can be no doubt about it that the Gas Commission will, certainly next year, or possibly this year, arrange for a stated number of Gordon lamps as a portion of the city's lighting scheme. Gas men visiting the metropolis should not fail to inspect this exhibition, which to our eyes is the perfection of street lighting.

PROGRESS AT LOGANSPORT, IND.—A few years ago, or when the present management of the Logansport Gas Light and Coke Company took charge, they were handicapped with a $4 per 1,000 sales rate. As the Company was in bad repute with the people, heroic treatment of the schedule was considered about the best way to deal with it, and a cut to $3 50 was ordered. In due time other reductions followed until the reasonable figure of $1.60 was reached. It was presumed that the halt at this point would be a prolonged one; but not so, for we are now informed by General Manager Rice that on May 25th a still further concession was granted. The gross price was cut to $1.50 per thousand, prompt payment (within 10 days) securing the following discounts:

Monthly Consumption.	Discount.	Net Rate.
Under 1,000 cubic feet.....	10 per cent.	$1.35
1,000 cubic feet and over...	20 "	1.20

This is perhaps as cheap a schedule as any now ruling in the country, when proper allowance for the conditions governing the supply is made. It also shows that gas men need fear no competitor in the race for favor with users of artificial light; for if a profit can be made in Logansport on gas at $1.20 per thousand what could be accomplished in other larger centers, were it in these places brought to a test as to what must be done to maintain supremacy.

THE Philadelphia Common Council has adopted an ordinance conferring authority on the Department of Public Works "to supply gas to consumers resident in adjoining counties whenever it shall be to the interests of the city so to do, and to make such regulations for the supply and for the collection of moneys due for the consumption of gas as it may deem proper."

THE San Jose (Cal.) Gas Light Company has purchased a controlling interest in the local Brush Electric Light Company.

THE Cape Island Gas Works have been purchased by Thomas M. Ferrell, of Woodbury, N. J.

GAS for fuel is sold in Poughkeepsie, N. Y,, at $1 per 1,000 cubic feet.

The Value of Covering Steam Pipes.

Prof. M. E. Cooley, M.E., of Ann Arbor, Mich., some time ago presented to the Michigan Engineering Society a statement of his experience on the value of covering steam pipes, more particularly with reference to the benefits ensuing from the prevention of radiation. In support of his position he gave the following illustration:

The Thomson-Houston electric light plant in Ann Arbor has about 60 feet of 7-inch pipe connecting the boilers with the engines, and two large steam drums above the boilers.

In March, 1887, the steam at the far end of this pipe was tested to determine the amount of entrained water, the pipes and drums at the time being uncovered. An average of nine experiments gave 31.01 per cent. of moisture. In June of the same year, after the pipes were covered with magnesia sectional coverings, the quality of the steam was again tested, the average of five experiments giving 3.61 per cent. moisture. The tests were made by the same men, from the same connections, and in the same manner. The pipes and steam drums in March were subjected to a draught, which, of course, aided the condensation. Enough water passed into the cylinders to retard the engines, producing a disagreeable noise. In June the weather was warmer, and the pipes and steam drums were well protected; the quality of steam at the boilers was tested in June, and showed about 3 per cent. of moisture.

Assuming that 100 I. H. P. were being developed at the time, and that each horse power required 30 pounds of steam per hour, we would need 3,000 pounds of steam. If the steam is assumed to have 25 per cent. entrained water due to condensation in the pipes and connections, then 4,000 pounds steam will need to be produced in the boilers, or 1,000 pounds more than necessary. To produce this steam will require about 125 pounds of good coal per hour, or 1,000 pounds per day of eight hours. One-half ton per day at $3 per ton for 300 days = $450, which, at 6 per.cent., pays the interest on $7,500. The actual cost of the covering put on complete probably did not exceed $150.

Effect of Light on Magnetism.

At a meeting of the London Physical Society Mr. Shelford Bidwell showed a lecture experiment illustrating the effect of heat on the magnetic susceptibility of nickel, and an experiment showing an effect of light on magnetism. In the first experiment a piece of nickel was attached to one side of a copper pendulum bob, which was held out of the vertical by bringing the nickel in contact with a fixed magnet. On placing a spirit lamp flame below the nickel, the bob was, after a short time, released, and oscillated until the nickel had cooled, when it was again attracted and the operation repeated itself.

The second experiment had been recently shown before the Royal Society. One end of an iron bar, which had been magnetized and then demagnetized, was placed near a magnetometer needle. On directing a beam of light on the bar an immediate deflection of the needle resulted, and on cutting off the light the needle promptly returned to near its initial position. The direction of magnetization induced by the light is the same as the previous magnetization, and the bar seems to be in an unstable magnetic state. That the effect is due to light and not heat, the author thinks is rendered probable by the suddenness of the action.

The President said he had tried the experiment himself and failed to get any effect, but after seeing the arrangement of apparatus used, he believed his non-success due to the comparatively great distance between his bar and needle. Mr. C. Richardson asked if the results were different for different colored rays, and Prof. S. P. Thompson inquired whether the magnitude of the effect varied with the intensity of illumination, as in silenium, and also if any change was produced by altering the direction of vibration of the incident light. Mr. G. M. Whipple wished to know whether any difference was produced by blackening the bars, and as bearing somewhat on the same subject, mentioned an induction magnetometer in which an iron bar used was demagnetized by plunging in hot water. The results obtained were very irregular after the first magnetization, and this may have been due to the instability shown to exist by Mr. Bidwell's experiment.

In reply, Mr. Bidwell said red light produces most effect, and blackening the bar makes the action much slower. As regards silenium, the character of the effect is similar, but he believes the causes to be different. Polarized light produces no change. In answer to Prof. Herschel, he said that any part of the bar is sensitive to light, and showed that illuminating both sides of the bar increased the effect.

The Personal Error in Photometry.

By Prof. Edward L. Nichols.

[A paper read before the American Institute of Electrical Engineers, New York, May 22, 1889.]

Whenever, in the course of photometric work, different observers have occasion to compare the same pair of lamps, it will be found that the results of their readings with the Bunsen photometer differ by an amount very much larger than the apparent mean error of a single observation.

Ordinarily, these differences are cloaked by the accidental errors due to the fluctuations of the lights under observation, and they have, consequently, not received the attention which they merit. There has been, indeed, so far as I know, no systematic attempt to determine the precise nature and importance of this personal error, the existence of which has doubtless been recognized by very many observers.

The introduction of the storage battery and the adoption of the incandescent lamp, supplied from the constant source thus afforded, as a secondary standard, has, however, entirely removed the large accidental errors resulting from uncontrollable fluctuations in our standard of illumination, and the personal errors just alluded to accordingly stand out in their true importance. I have very recently had occasion to make some experiments upon this subject, the results of which may be of some interest to those who have occasion to work with the Bunsen photometer.

The character of the errors with which one meets continually, whenever the readings of two or more observers are brought into direct comparison, may be very well shown by means of two sets of readings made by Mr. B. W. Snow and myself upon the same pair of lamps. These observations were made under precisely similar and uncommonly favorable conditions. The two lamps in question were of the same type, and being the only lamps in circuit with a large storage battery, they could be maintained at an almost absolute constant voltage. The two sets of readings are not presented here as an example of what may be done with the Bunsen photometer in the comparison of constant sources of light. They are indeed of no great accuracy, and contain larger accidental errors than some observations to which I shall have occasion to call attention presently. They exhibit, however, very clearly the existence of the personal errors of observation which are to form the subject of this paper.

Table 1.

Two parallel sets of ten readings upon the candle power of an incandescent lamp.

(1) (B. W. S. observing.)			(2) (E. L. N. observing.)		
Readings. C. P.	Differences. C. P.	Per ct.	Readings. C. P.	Differences. C. P.	Per ct.
12.12	.112 =	.91	12.56	.044 =	.35
12.32	.088 =	.72	12.60	.084 =	.67
12.16	.072 =	.59	12.36	.156 =	1.25
12.16	.072 =	.59	12.56	.044 =	.35
12.28	.048 =	.39	12.64	.124 =	.99
12.40	.168 =	1.38	12.60	.048 =	.67
12.28	.048 =	.39	12.56	.044 =	.35
12.08	.152 =	1.30	12.40	.116 =	.93
12.12	.112 =	.92	12.32	.196 =	1.35
12.40	.168 =	1.24	12.56	.044 =	.35
		Averages.			
12.232	.104	.852	12.516	.089	.717

It will be seen from the above table that while the apparent mean error of a single observation is only about one-tenth of a candle, and the probable error of each set only .022 candle, the two averages themselves differ by .284 candle.

The following experiments were made for the purpose of determining the nature of this personal error:

Three incandescent lamps of the same type and voltage were selected, care being taken to choose specimens the carbons of which were as straight as possible. These lamps gave 16 candles at 110 volts. They were connected in multiple to the terminals of a storage battery giving a potential difference of 120 volts. Adjustable resistances of German silver wire were placed in the line leading to each lamp and in one of the mains leading from the battery. (See Fig. 1.)

The lamps, together with the above-mentioned resistances were set up in a photometer room which contained two Bunsen photometers. The connecting wires were of such length that the lamps could be moved from one photometer bar to the other without breaking connections. One of the lamps was set up as a comparison standard at the end of the shorter bar. Each of the other lamps was then compared with this standard, the resistances being adjusted until these lamps were found to bear the same relation as to brightness to the standard. In other words, they were brought to the same intensity by a method which eliminated the systematic personal errors which it was my purpose to study.

The two lamps were then placed at the ends of the longer photometer bar, the length of which was 400 centimeters. It was divided into 800 equal parts. The lamps had been measured with the planes of the filament at right angles with the photometer bar, and care was taken in

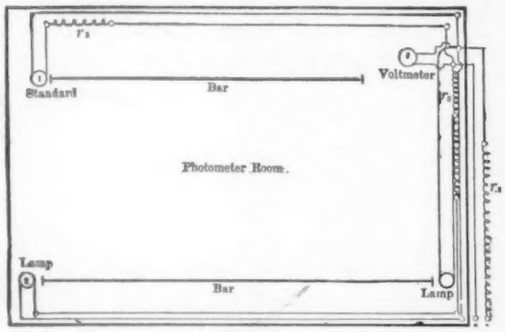


Fig. 1.

setting them up in their new position to place them at the same angle and presenting the same face to the bar as before. A closed circuit voltmeter between the terminals of the battery enabled the observer at the beginning of a set of readings to bring the lamps to the proper potential. In order to insure greater constancy in the degree of incandescence throughout the series of tests, the lamps were maintained at a potential considerably below the normal, their candle power being about 12 instead of 16 candles.

A number of observers, all of whom were accustomed to photometric measurements and some of whom had had extended experience, were asked to make a set of ten readings each upon the two lamps. The results of these two readings are given in Table 2.

Table 2.

Ratio of two incandescent lamps, previously adjusted to equal brightness. The measurements are made in the usual manner, by means of the Bunsen photometer.

I_r and I_l are the intensities of the right-hand and left-hand lamps respectively:

Observer.	Ratio, $\frac{I_r}{I_l}$	Personal Error.
A	1.0590 ± .0040	— .0558
B	0.9701 ± .0044	+ .0331
C	1.0021 ± .0022	— .0189
D	1.0191 ± .0072	— .0159
E	1.0182 ± .0039	— .0150
F	1.0902 ± .0057	— .0870
G	1.0733 ± .0053	— .0701
H	1.0293 ± .0042	— .0261
I	1.0297 ± .0050	— .0263
J	1.0220 ± .0027	— 0.188

The true value of the ratio, $\frac{I_r}{I_l}$, determined previously by comparing each lamp separately with the standard, was 1.0032 + .0015, which value was used in computing the "personal" error.

It will be seen from inspection of the table that none of the averages fall at the middle of the bar, nor are they distributed around it in such a manner that the most probable value of the entire series, calculated by least squares under the assumption that only fortuitous errors exist, approximates to unity as it should do, were the lamps of equal brightness and were there no systematic errors to vitiate the result. On the other hand, the readings lie, with a single exception, on one side, namely to the left hand of the center of the photometer bar. It will be seen moreover, that the probable error calculated for each set separately, without taking cognizance of any systematic error, is very small in comparison with the differences between the mean results of the various sets, and especially in comparison with the variations of those averages from unity.

The Bunsen disc with which these observations were made was mounted in the usual manner, the two sides of the disc being viewed simultaneously by means of two plane mirrors set at the proper angle behind the former. It was noted that the almost universal habit in reading was to use the two eyes independently, one eye fixed upon each side

of the disc. It seemed probable, therefore, that the personal error arose from the unequal sensitiveness of the observer's eyes, in that he would unconsciously set the disc at too great a distance from the lamp which illuminated the side of the disc which was being observed by his more sensitive eye. It appears, if we accept this explanation, that the right eye was the more sensitive in all the cases under observation excepting one, that of the writer (see Table 2, B), whose readings would indicate the opposite peculiarity.

In order to reverse the relation of the observer to the photometer bar, without altering any of the other conditions of measurement, a large mirror was set up opposite the photometer at a distance of about 40 centimeters. The observer, by sitting with his back to the bar, could then see the images of the Bunsen disc in the mirror, and his right and left eyes were reversed with reference to the lamps. Sets of ten readings were made in this manner by some of the same observers as before, the object being to test the hypothesis just stated. The results thus obtained were, however, complicated by the unforeseen circumstance that the method of using the eyes in observation was not the same when the image of the disc was seen in the mirror as when it was viewed directly. The observer, when using the mirror, no longer used his eyes independently, but scanned the image as a whole, so that both eyes had a share in determining the brightness of each side of the disk. The result was to produce a change in his settings not by introducing a systematic error equal and opposite to that occurring in the first series of observations, as had been expected, but by eliminating the error in question. In a word, the settings with the mirror were in better agreement than those made by direct observation, and they gave results much more nearly in accordance with the known equality of the lamps.

In my own case, however, an exception to the above statement must be noted. Very possibly as the result of an effort to repeat with the mirror the precise method of observation followed in making the direct settings, I continued to use my eyes independently, viewing the image of one side of the disc with the right eye, the other with the left. There resulted a set of readings, such as I had expected to obtain from all the observers, the mean of which lay as far from the center of the photometer bar as the mean of the direct readings, but upon the other side. (Compare sets "B," Tables 2 and 3.)

The results obtained with the mirror are given in the following table:

TABLE 3.

Ratio of the two lamps, determined by observing the images of the Bunsen disc in a large mirror; the observer placed with his back to the photometer bar:

Observer.	Ratio, $\frac{I_r}{I_l}$	Personal Error.
A	1.0070 ± .0026	.0028
B	1.0444 ± .0011	.0414
C	0.9964 ± .0053	.0068
F	1.0141 ± .0025	.0109
G	1.0004 ± .0056	.0028
H	1.0134 ± .0045	.0102
I	1.0004 ± .0031	.0028

The observations with the mirror were followed by four sets of direct readings made with one eye bandaged. It was found that although more fatiguing, these monocular settings were made with a feeling of certainty on the part of the observer which had not accompanied the settings made with both eyes. In the latter case, indeed, a conflict between tendencies to set the disc in two distinct positions had been very apparent, the observer unconsciously choosing now one, now the other, as the true position. The set of readings, given in full in Table 4, will serve to illustrate the result of this tendency. The instances in which the observer seems thus to have temporarily changed in his judgment of the true setting, are printed in heavy type.

TABLE 4.

No.	Reading.	No.	Reading.
1	1.033	6	**1.048**
2	1.022	7	**1.053**
3	1.021	8	1.023
4	1.023	9	1.033
5	**1.050**	10	1.030

This tendency to vacillation disappeared almost entirely when only one eye was used. The readings obtained with a single eye not only agreed much better among themselves than those made under like conditions using both eyes, but the results obtained with the left eye were identical with those obtained with the right eye, and both seemed to be entirely free from the systematic personal error that had been found to vitiate readings made in the usual way.

The results of such a set of monocular readings, made by Mr. Snow and myself, all other conditions remaining the same as in previous trials, are given in Table 5.

TABLE 5.

Observer.	Eye Used.	Ratio.	Personal Error.
B. W. S.	(Right.)	1.0028 ± .0019	.0004
B. W. S.	(Left.)	1.0001 ± .0010	.0031
E. L. N.	(Right.)	1.0001 ± .0017	.0031
E. L. N.	(Left.)	1.0031 ± .0018	.0001

It will be seen that the probable error of each set is much smaller than in the sets of observations made with both eyes; also that the readings of two observers, whose mean results from similar sets with both eyes had differed by 8 per cent. (see sets "A" and "B," Table 2), are in complete agreement.

Finally, it will be noted that the results of these four monocular series differ from the accepted value of the ratio of intensities of the two lamps (1.0032) by an amount less than the probable error of each set.

It had been my intention to extend the experiments described in this paper to a much larger number of observers. The evidence obtained, however, seemed quite sufficient to establish the existence of the personal error in photometry, and to show that it was in general very far from being a negligible quantity. Frequent repetitions showed that, in my own case at least, the error was very nearly constant, and I think that it would be quite possible to establish a personal equation, and to apply the proper correction.

A much better plan, however, would be to so modify the photometer car itself as to insure the use of both eyes in the inspection of each side of the illuminated disc. Several forms of photometer, already described, partially fulfill the necessary requirement. Any device which would bring the images of the opposite faces of the disc into a vertical line in the field of view would doubtless serve to eliminate the error in question. Observations with such a photometer would correspond in character to the "monocular" readings given in Table 5. Not only would they be free from the systematic error to which the ordinary form of Bunsen photometer is subject, but the accidental errors would be much smaller, and the degree of uncertainty which attends the determination of candle power by our present methods would be in great measure diminished.

Ventilation by Gas.

By J. F. SIMMANCE.

[Contributed by the author at the Liverpool Meeting of the Royal Institution.]

It is difficult, in a paper like this, to avoid going over ground already familiar to you; as probably ventilation, as a science, has been studied as much as most subjects. But ventilation in connection with gas lighting, although in itself pretty old (having been first introduced by the late Mr. J. O. N. Rutter, of the Brighton Gas Company, in 1833), is, as a study, comparatively new to most persons. Naturally, its fundamental principle, of producing a movement in the atmosphere by effecting a difference in specific gravity by expansion, is taught in all elementary schools; but a practical application of it to combine artificial illumination with sanitation, and thus to utilize the heat-giving properties of coal gas in a way calculated to turn them into distinct advantages, is, I think, little known. In fact, I may go so far as to say that ventilation itself is not well understood, in spite of the attention which has been given to it. For instance, in a neighboring town hall (a new building), a few nights since, during a dramatic performance, some of the star lights were extinguished by accident, and being turned on again unlighted, we in the auditorium could distinctly perceive the odor of the escaping gas, although we were 30 feet below the burners, and this in spite of the most modern ventilating appliances fixed in the roof. Again, nearer home, in one of our public buildings, an escape of gas at the top of the room, immediately beneath a range of 24-inch mechanical ventilators, can be detected at once by any one in the room. This is not ventilation; but I have no hesitation in saying that, with a properly arranged system, all gas would, under the circumstances, pass away unperceived. In a properly ventilated room, you should be able to smoke a cigar through to the end, and yet a person coming in a few minutes after should not be able to detect any odor. The air should be constantly changing, as water in an aquarium is constantly renewed. Certain exhalations from the lungs should be removed, and a requisite supply of air, in such quantities as to make such impurities removable, should be admitted. It should be noticed that no more inlet and outlet is required per person in a small room than in a large one; and the provisions of the Medical

Boards, that every hospital patient should have a certain number of cubical feet of space in the room is, to my mind, a tacit confession that the ventilation is not to be relied on, and that in consequence it is necessary to make such provision that patients shall not be *quickly* inconvenienced. What is the first thing done in the morning? To open windows, etc., to dilute the accumulated and stagnant impurities of the night. And the provision of a great cubical area per inmate is simply a precaution in the way of diluting the impurities as much as possible. I must, of course, admit the beneficial effects of large areas, as they have the very good effect of maintaining a more equal temperature by lessening the effect of wall radiation, which would soon make a small apartment uncomfortably warm, ventilation or no ventilation. But a man should exist as healthily, so far as his breathing apparatus is concerned, in a cell just large enough for his body, as in a cathedral, provided he is not required to breathe the same air twice.

I have, in the first place, to point out that a combination of gas lighting and ventilation is the cheapest and most efficient method of effecting the best results in each. There are, roughly speaking, four methods of ventilation—(1) diffusion, (2) specific gravity, (3) vacuum caused by the action of wind on cowls, and (4) fans driven by mechanical power. You will say at once that the two first and the two last are identical. They are, practically; but I prefer dividing them thus.

The diffusion method of ventilation is the way in which most living-rooms are ventilated. The diffusion between the warmed interior and the fresher air outside takes place gradually through plaster, bricks, etc. The chimney also draws in its supply from the windows and doors, which supply comes straight across to the fire, leaving the top stratum of heated products almost untouched, except by diffusion. Even with a large fire in a room, the air close to the ceiling is generally unbearable. But it must not be forgotten that a good deal of the heat there is heat radiated from the ceiling, and is not heated products. In many cases air bricks are let into the outer walls of rooms, high up, presumably to allow the heat to escape; but then real ventilation is generally set up unintentionally, as these all act as inlets, and the air current cools down the hot products in its passage through them to the fire, and probably brings them within the range of the chimney's attraction or vortex. The obvious objection to this is the cold draught upon the heads of the persons in the room. A distinct case of this sort of ventilation can be experienced near Liverpool, where the architect—a man of much eminence—has, in dealing with a room some 35 feet by 25 feet, inserted two ventilators, each of about 12-inch capacity, in the ceiling, and carried them out at the ridge; there are also 10-inch by 5-inch inlets arranged round the room. With such an array, one would expect good results; but, unfortunately, there is a large fireplace at one end of the room, and the heat evolved by the combustion of about ½ cwt. of coal at the base of a chimney-shaft running up level with the ventilators entirely upset matters. Instead of the chimney drawing its supply of air from the inlets placed so invitingly in the walls, it is capricious enough to prefer getting in at the 12-inch grid in the ceiling. The room is ventilated; but, standing in a familiar attitude before the fire, the draught upon one's head is excruciating. In fact, the coldest place and time is before the fire when one's clothes are scorching. All this naturally alters when the doors or windows are opened.

The second method of ventilation is by specific gravity, or artificially increasing the difference in temperature between the air to be removed and that to be inducted. In the case of the fire draught that also is by specific gravity; but, as I have said, I prefer classing them separately.

I now come to mechanical cowls, ventilators, etc.; and I must say at once that I have had very little experience with these, but evidently their extracting power varies as wind-force varies. Fans driven by power are not common except in mines, tunnels, etc., and it does not seem necessary to go into that subject.

Now, the point of this enumeration of these different systems is as follows: In the case of diffusion, as the quality of our bricks and plaster varies, and the fitting of our windows and doors approaches perfection, and as we have a big or a small fire, so will the effect upon the room vary. It is not a reliable system of ventilation, nor can it be put down, even approximately, in figures. With a mechanical air-pump cowl, the wind-force varies; and with a cold, still atmosphere it appears to me that the heavy cold column of dense air in the vertical flue would drop straight down as a shower bath, should a slight warmth be generated in the room below. Again, it appears to me that ventilation so obtained is not a constant quantity. With a mechanical fan, the quantity is constant, but for ordinary use it is out of the question. I am informed that at our town hall a fan is driven by a gas engine, and acts perfectly. Naturally it does; but to use one set of gas apparatus for lighting and another for ventilation is like having one fire for warming a room and another to induce a draught up the chimney. But by utilizing the heat of the gas lights for ventilating by specific gravity, the amount of output is entirely under control—it is practically unaffected by extraneous circumstances. A certain heat is produced by the combustion of a given quantity of gas. The area and height of the ventilating shafting are arranged in accordance with actual requirements and known rules; and although these rules point out that small variations must occur, the range of these variations is so easily calculated that, as I have said, this system of induced draught is practically unaffected by any uncontrollable circumstances. Thus in certainty and efficiency we can only compare ventilation by gas lighting with mechanically worked fans; and when we look upon them from an economical point of view, the fact that one lights and ventilates at one and the same time, places it at once in a position of superiority.

Now, before going into the more technical part of our subject, I should mention electricity as a lighting agent. I do not for one moment presume to say a word as to its future; but, perhaps, on consideration, you will agree with me that a lighting system which admits of its combination with sanitation is likely to maintain a foremost place. The absence of heat, which has been unthinkingly indicated as the great advantage of the electric light, is undoubtedly its very great disadvantage; as, in addition to the cost of lighting, some other system of inducing a movement in the atmosphere of apartments must be adopted. When the actual advantages which a hot light possesses are fully grasped by architects, a more severe blow will be dealt at indoor electric lighting than any it has yet received by the development of gas lighting.

Having now laid before you my reasons for believing the subject of my paper to be worthy of careful consideration, I will proceed to place before you a few elementary particulars as to methods of arriving at a proper basis for the construction or ordering of gas ventilating apparatus, of descriptions suitable for any sized apartment. Naturally, the number of persons in the room, the quantity of light required, etc., cause this apparatus to require modification under various circumstances; but the simple formulæ I propose to mention are, I think, of such a nature as to admit of any person, whether architect or not, working out a scheme of ventilation for his own large or small rooms.

The data upon which we must base our calculations are:

1. The light required for adequate illumination.
2. The amount of gas required for producing that light.
3. The seating space of the room (number of inmates).
4. Air required to supply (*a*) the lungs of the persons present, and (*b*) the gas lights.
5. The temperature of exhalations from the persons present and of the products of gas combustion.

It will be seen that if we have all this information, we shall know the amount of air required by means of inlets, and the quantity for which we must provide exit. The former may be left to itself so long as it is in excess, as naturally it is the outlet which governs the inlet.

Now we come to the information required for estimating these outlets:

6. The length of the upcast shaft.
7. The temperature of the external atmosphere.
8. The temperature of the mixture of products of combustion and vitiated air at the base of the upcast shaft.

The question of this upcast shaft I will deal with later. For real induced extraction, a vertical, or at least a rising shaft is a necessity, if the outlets are to be kept of a reasonable size, as the addition of a tube 12 inches square, 10 feet long, to a 12-inch aperture in a roof would treble the output, with a difference of 25° between the two atmospheres.

The methods of estimating the various points I have enumerated are as follows:

The light required for adequate illumination varies, of course, for rooms for different purposes; but I shall take as a fair average that the light at the ends of the room shall be equal to that given by one standard spermaceti candle (six to the pound), burning at the rate of 120 grains per hour, held at a distance of two feet from the wall or surface to be lighted. This is equal to 0.25 candle, as you know that light decreases in inverse ratio to the square of the distance. So we get—

$$CD^2 = \text{Illuminating power of light required;}$$

D being the distance from the proposed position of the light, and C the amount of light required upon the wall or table.

I may say that $\frac{1}{16}$ of a candle, held at rather more than 3 feet from the wall, is a fairly good light; but anyone with a standard candle can judge for himself the light required and calculate accordingly.

Having now the means of ascertaining the power of light required, we pass on to the amount of gas required to give that light. Naturally, this varies with the quality of gas in the town; and in a greater degree upon

the style of light used. Liverpool gas, burnt at the rate of 5 cubic feet per hour in a standard batswing burner, gives a light equal to about 21 standard candles, and is thus called 21-candle gas. We will base our calculations upon this.

We now proceed to discuss the kinds of ventilating lights; and I think we may take these as three in number.—

1.—A well-governed cluster of flat flames, burning from non-corrodible steatite burners.

2.—A compound Argand.

3.—A type of lamp called (I do not know why) a regenerative lamp.

You observe that I do not mention the sun-burner, with little stars of flames projecting horizontally, which, although used largely in theaters, is too unscientific and extravagant to be extensively employed in the future. One removed from the Bank of England, in London, and tested in a photometer gave the magnificent result of 1 candle per foot of gas burnt. As all the three systems I mention yield upwards of 7 candles per foot, I think we need not consider the old-fashioned system.

The cluster of flat flames gives an illuminating power, when in a properly arranged sun-burner, of about 7 candles per foot. Its advantage is the absence of any glass which might require cleaning, and the brilliantly warm tone of the light it throws. The compound Argand is a series of concentric rings of steatite with well-arranged air supplies, and a flash or pilot light in the center for burning constantly. The glass chimney is short and not liable to break, One going in my own office here has been alight night and day for more than 12 months, and the original chimney is still intact, and I expect it to last for years. This type of light gives over 8 candles per foot. The so-called "regenerative" lamp is an arrangement by which the heating of the flame is facilitated. Large quantities of oxygen—the maximum amount, in fact—can be brought into the flame without impairing its steadiness. Also arrangements are made for preventing a cooling down of the flame by cold currents. This light (fitted with opal reflector) gives the highest result known—viz., an effective downward light of 18 candles per cubic foot of gas.

We can now estimate the quantity of gas required for producing the amount of light we have found requisite—

$$\frac{I}{d} = \text{gas per hour.}$$

As to the number of persons likely to be in the room at one time, this will be a fixed quantity, and must be taken as the maximum seating capacity.

We now come to the amount of air required for (*a*) the lungs of the people, and (*b*) gas combustion. An adult breathes about 15 times a minute; each respiration being about 30 cubic inches of air, which should contain one-fifth oxygen. The air we breathe appears to be nearly alike in composition everywhere, and contains traces of sulphureted hydrogen, ammonia, etc., but is practically a mixture of carbonic acid, oxygen, and nitrogen. The carbonic acid exists in only about 5 to 10,000 volumes. On respiring the air a change takes place, both in the blood itself and in the air. With the former we have nothing to do. The air is increased in temperature, being at its expulsion at the temperature of the lungs themselves, and only varying a few degrees according to the time it remains in them. The carbonic acid of the air is increased and its oxygen diminished in nearly the same ratio. We thus see that each respiration or expiration is the means of removing a certain proportion of carbon from the lungs. It is also proved (if I remember rightly, by Allan and Pepys) that after being charged by re-respiration with 10 per cent. of carbonic acid, it would not take up any more, even if breathed over and over again until life was extinct. From every volume of air about 4½ per cent. of oxygen is changed by its combination in carbonic acid, and rather less than 4 per cent. of carbonic acid takes its place. This is only an approximate amount, as the quantity of carbonic acid in respired air varies very much under different circumstances. There are some peculiar features about this. For instance, women exhale less carbonic acid than men of the same age, with whom it increases gradually up to 40 years of age; and then, after remaining stationary for a time, diminishes. In the case of women, it is stationary for a large part of their lives. Then external temperature varies the amount of carbonic acid exhaled; as within 38° and 75° F. every 10° rise diminishes by 2 cubic inches per minute the carbonic acid exhaled. Also, more carbonic acid leaves our lungs in spring than at any other time; more also when the atmosphere is moist than when it is dry; more when food is consumed than when we fast; more when farinaceous is used in larger quantities than animal food. A fair average is 1,346 cubic inches per hour, or 8 ounces of solid carbon in 24 hours. Now, taking the figures as just stated—that 4½ per cent. of oxygen is abstracted and 4 per cent. of carbonic acid added at each respiration, and also the fact that 10 per cent. of carbonic acid is poisonous, we have in 100 volumes of air, after a first respiration, 4 per cent. of carbonic acid, 7.8 per cent. after the second, and then at once we reach the point where the injurious effect comes in. It will be seen that having 21 per cent. of oxygen in each volume of air, and exhausting this at the rate of 4½ per cent. per respiration, there is still a supply of oxygen, although the limit of healthy breathing has been passed at the third breath. But carbonic acid and water are not the only products from the lungs. Wiederhold has stated that ammonia, chloride of sodium, uric acid, and urate of soda and ammonia may be very readily detected in the condensed vapor of expired air.

I have gone thus into this point to show that, in my opinion, ventilation can only be accomplished by causing a steady upward movement in the atmosphere of a room, and introducing entirely new oxygenating material.

As I have said, an adult requires about 450 cubic inches of air per minute, 27,000 cubic inches or 16 cubic feet per hour. In Molesworth and many other books 3 or 4 cubic feet per minute is given as a man's requirements; and it looks to me as if they had confused square inches and cubic inches. But, to be certain, I consulted an eminent surgeon, who corroborated these figures of mine, and pointed out to me a list of authorities, unconnected with ventilation, but intimately acquainted with the wants of the human lungs, whose calculations give me ground for my 16 cubic feet per hour. Naturally one would allow a margin, and I propose estimating upon 20 cubic feet per hour.

The second part of our fourth point is the air required by the gas lights, and which alters according to the type of light. In the cluster of flat flames I have here no artificial means are used to create a draught. In the compound Argand, arrangements are made to supply air at the base of each ring of flame, and a separate intake of air between the glass and copper chimneys aliments the tips of the flames. I should say that with a 16-candle gas this Argand gives 33 per cent. more light than the flat flames, it having been constructed by Mr. Wm. Sugg (the inventor of both systems) for that quality of gas. He has now perfected an arrangement of elongating the air chambers of the burner so that with Liverpool gas it should as far surpass the flat flames in duty as it does in London with the poorer gas.

With this "Cromartie" lamp the currents of air impinging on both sides of the flame do so at right angles to its surface, and in obedience to the induced draught of the eduction tube, spread along the flame in most intimate connection. By this arrangement a large quantity of air is drawn through the lamp. But as the air supply varies so considerably, being affected by the size and type of lamp, the quality of gas, etc., in order to avoid complication in our calculation I have decided to take 20 cubic feet of air per cubic foot of gas burnt as a maximum quantity which will meet the demands of either of the systems discussed.

The reason for requiring the temperature of the exhalations of the persons present and the gas combustion is, of course, to enable us to calculate the expansion; for it is certain that a cubic foot of air coming into the room is in a very different condition when it goes up the ventilating shaft. But the breath from the lungs will be diluted to such an extent by the surrounding atmosphere (which we may take roughly to be 65° F.) that its 98° will be reduced to 70° within 18 inches of the lips, which makes the question not worth considering. But the heat of the gas is a more important matter; for it is by means of this heat that the products, shooting up the inner tube, diffuse themselves all over the outer tube area within a foot or so of the end of the inner tube, and obviously draw in large quantities of the atmosphere which jackets the inner tube. In fact, the inner tube acts like a steam jet ventilator or water spray, and in addition superheats this jacket of steam and vitiated atmosphere, and so accelerates its passage up the shaft.

It appears reasonable that the "Cromartie" lamp should not be so hot at the outlet as the others. So much of the heat of its gas combustion is transformed into radiant heat on account of the extent of absorbent and radiating surfaces with which the products of combustion are in contact, that (comparatively) very little is left in them. The Argand would appear to be as hot as any; the entire heat being gathered in a small compass, and projected upon a small space, comparatively uncooled by the surrounding atmosphere, which immediately lowers the temperature of the more accessible products of the flat flames. Judging the heat at a sufficiently great distance to admit of any possible dilution and cooling to take place, at the exit of the inner tube only we find that to estimate 750° as the heat of the gas combustion at a maximum will give us the means of calculating our point of the temperature at the base of the eduction tube. You must not forget that this is the inner tube only; the aggregate of the inner and outer, when complete diffusion or dilution takes place, is much lower. The estimate of 750° is too

high for the "Cromartie;" but I do not think that, taking all points into consideration, we shall do harm by calculating all the lights alike.

So far we have been seeking data to enable us to compute the volume of air we require to find its exit hourly. We now answer questions Nos. 6, 7 and 8. The height of the vertical shaft must, in a great measure, depend upon the architectural necessities of the building, and may be looked upon as arbitrary. If you cannot get height get area; if you cannot get area get *heat*. By-the-way, do not infer from this that, not getting area or heat, *height* will do. The temperature of the diluted products of combustion at the base of the upcast shaft is as nearly as possible 400°. The temperature of the external atmosphere is the mean between, say, 30° and 90°, or 60°—a good average.

Having now gathered together all our data, we can formulate them; but before doing so we must look for a moment at the principle upon which we are working. The expanded air is forced up towards that stratum of the atmosphere where the rarefaction is equal to its own. Should it not lose its heat, and yet be protected against diffusion by confinement in a shaft, it should rise until an equilibrium is restored. But with our subject we find the hot products get cold by the absorption of heat and re-radiation by the flue material itself. We can keep the products together by a flue, and so make more use of their ascending power by preventing diffusion; but the loss of heat is completely damaging to any great confinement in the flue, and consequently to any minute detail in the calculations concerning it. We know the rules of falling bodies; but they do not apply at all to this, though they would do so if it were not for this loss of heat. There is a known variance between the specific gravity of the heated products and the cooler atmosphere; but its preservation depends to a large extent upon the material and position of the flue. A comparison, though not a good one, is that of a cork deep down in the sea. It preserves its own specific gravity amidst the enormous pressure of water, and when released from that great depth bounds upwards. But its relation to the specific gravity of the sea alters as it gets near the surface; in fact the water gets lighter, so to speak. Perhaps a better comparison would be a balloon of hydrogen, with a hole in the crown allowing a constant escape of the inflating gas, released from the earth. I am aware my comparisons are not good, but there really is a difficulty in finding a parallel with the products of combustion whose increase of weight is so variable, and is acted upon by so many causes—material of flues, outside weather, barometer, etc.

But we can, perhaps, do better. We may take the results of varying experiments, and accept a formula that will cover all these results; so that if you propose to use an iron, brick, earthenware or zinc flue on a roof or under floors, in a wall, or on its outside face, your ventilation will come out right.

Let C = Candle power required.
D = Distance from farthest wall to position of light.
I = Illuminating power of light required.
d = Duty per foot of gas.
A = Air per foot of gas.
a = Air per person.
N = Number of persons.
v = Volume uncorrected.
T = Temperature (F.) at base of tube.
V = Volume corrected.
H = Height of tubes in feet.

$$CD^2 = I. \quad \left(\frac{I}{d}\right) A + aN = v.$$

$$\left(\frac{v}{480}\right) \underline{T - 60} + v = V \quad \sqrt{H\,(T - 50)}\ 720 =$$

the quantity discharged under these conditions through a tube 1 foot in area per hour. As this quantity is to the quantity required to educt V, so is the necessary area of tube to one foot (144 square inches).

I will now take as an example a small room 40 feet square by 25 feet high, and seating 400 people. Supposing we propose to use one light, we require the distance from the center of the ceiling to the wall at the floor line. The height being 25 feet, we get a triangle of 25 feet perpendicular and 25 feet base, with a hypotheneuse of 32 feet. The square of the hypotheneuse multiplied by the desired power of light upon the wall (say, 0.25 of a candle) gives us 256 candles, which is not enough if the room is decorated with absorbing colors. Dividing candle power by duty per foot of gas (say 8), gives us 32 feet per hour. Then 400 people require 8,000 cubic feet of air per hour: the gas requires 640 cubic feet, which expanded (after adding the 32 feet of gas) to 400°=14,552 cubic feet per hour for which we desire inlet or outlet. As I have said, we can get inlet in excess; our point is outlet. Multiply the square root of the height (in feet) of the shaft you can command, multplied by the diluted temperature at the base of the shaft (400°), less the outside temperature, by 720. We will say the construction of our ceiling allows of a 5-feet vertical shaft, we thus get a passage of 29,520 cubic feet should the shaft be 12 inches in diameter. This would change the entire air of the room in about an hour and a half; the air issuing at the rate of about 6 miles an hour. We do not require so large an outlet; in fact, the less we can do with, the less likelihood of draught, apart from the question of cost. So, as the 14,552 cubic feet we want is to the 29,520 cubic feet, so is our required area to 1 one foot square. Then a 9-inch diameter round flue would fulfill all our requirements. As a matter of fact, lights to illuminate such a room are constructed, as a rule, by the best firms, with 9-inch shafts. With such an arrangement ventilation is certain, provided the most elementary philosophical laws are complied with; it can be produced in a moment by turning on the gas-cock; the ceilings are kept free from all discoloration by the combustion products; and the general effect in light is superior.

I now pass on to a few points of interest which may, I think, forestall some queries from you.

Down-Draught.—This should never be a difficulty when the building is not surrounded by higher buildings, and has no direct communication with any larger apartment or building; neither obviously, should it have a large fire going in the same room as the ventilating light, unless the proper inlets for air are allowed. I have, I think, shown that our ventilation is derived from heat at the bottom of vertical shafts; so a fire and a ventilating lamp in the same room must be considered in the light of our formulæ. If the light gives the greatest velocity to the air, the fire must suffer; if the fire is the hottest, the light will not work. But give the fire enough air by inlets to supply the chimney, and give the light enough air for its shaft, and both will work well. At a club smoke-room near here there is an old-fashioned sunburner with a shaft having an outlet on the roof. The fireplace of the room holds a fairly good fire, as a rule, and insufficient inlets are provided, so the fire gets most of its air from the sun-light—all the combustion products being drawn straight down, mixed with outside air, to the fire. Now, in the summer, when no fire is going, and the room is actually cooler than the sun-baked chimneys, I have no doubt that the sunlight will ventilate—drawing its air from the chimney by reason of the superior velocity of the gas-heated products. Then, to secure a constant upward-current, it must not be forgotten that the heat in the chimney must be sufficient to expand in some degree the whole column of air. If the tube is in an exposed condition, and is made (say) of sheet iron, its length is not doing much good unless the tube is warm for the whole of its length. If you were to make two flues of equal length and area, standing side by side, one in a brick setting and one in a sheet-iron tube, both communicating with a closed chamber in which a fire was burning, the one with the least radiation would be the upcast, and the other the intake.

Going back to my question of fires and ventilating lights, if only enough air can be obtained to supply the fire, the flue of the light may run into the chimney-breast; but then you must diminish the register space of the fire in order to leave some air for the light.

In the event of the room to be lighted and ventilated being (say) at the bottom of a well formed between high buildings, you have two courses open—either to carry a flue to the top, and use a very hot light; or to carry the flue into a neighboring chimney running right up, in which case you must operate upon the register of the fire at the base of the chimney, as I have said.

One apparent objection to ventilation by gas is that in the day time the gas is not burning, and then ventilation is stopped. But do not stop it. Have a single burner going, or, if it is a crowded meeting, light up the whole. Gas is cheap. The lighting of a room seating 400 people, as I have before mentioned, only costs a penny; and surely it is better to pay a single penny per hour than to be imbibing, for the term of the meeting, all your neighbors idiosyncrasies into your own constitution. The apparent objection is not a valid one. You may say, too, that it is not always one has to deal with a room from which a vertical shaft is practicable, and horizontal flues must be used. This is frequently so, but the remedy is obvious. Place a well-protected vertical shaft outside, and connect your horizontal flue, which should, of course, be of some non-conducting material. The point is to get the base of the vertical tube hot. Such an arrangement will ventilate just as well as a vertical one, only you will require more heat to keep the extra length of pipe warm. That is where the utility of different kinds of lights comes in; you can choose the one that will suit your convenience.

Danger of Fire.—Non-conducting pipes should be used for all flues; and if the junctions are properly luted, no danger need be apprehended. A gaslight will, at close quarters, heat a sheet of iron red hot; but there are many known kinds of pipe which I have never found capable of being heated to that extent. The objections sometimes raised by insur-

ance companies to ventilating lights have been elicited by slovenly arrangements and cheap scamped work. But a good system of non-conducting pipes carries its recommendation on its face; and the best known companies have approved of installations of ventilating gas lights so arranged.

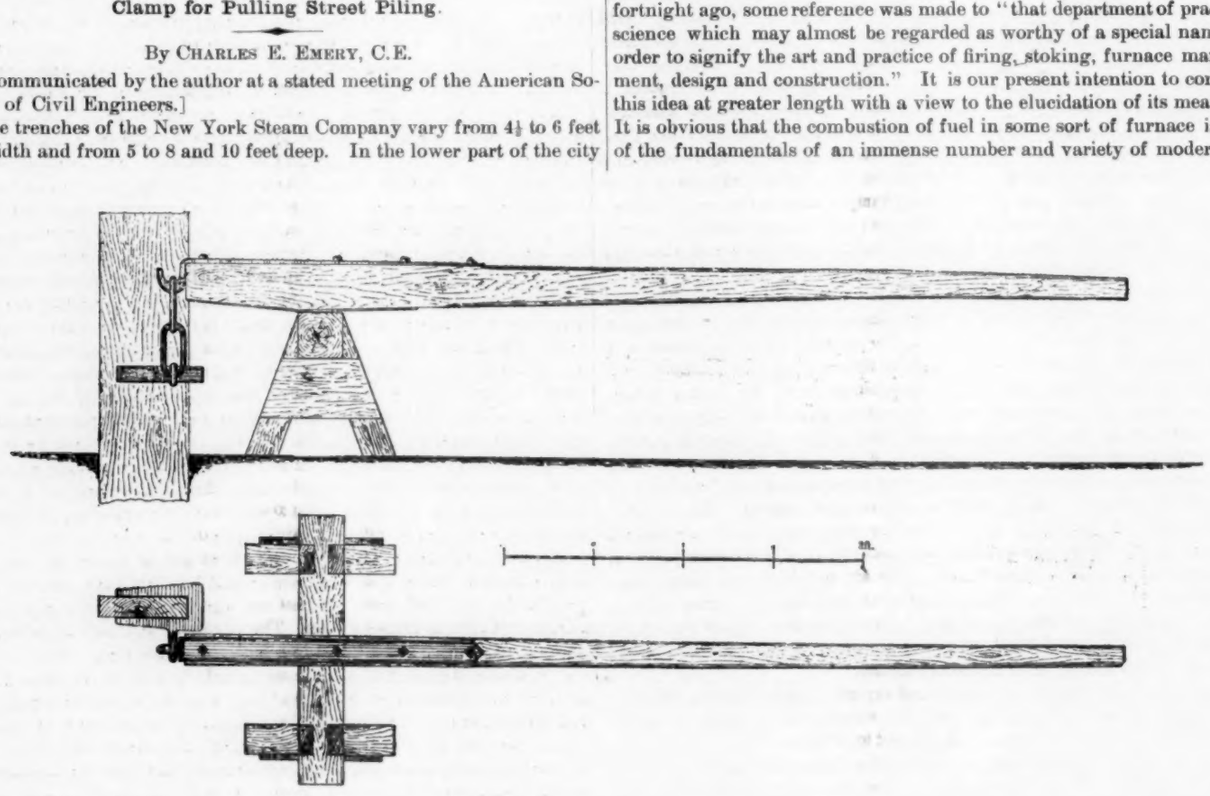
In conclusion, ventilation by gas has only comparatively recently been deemed at all worthy of architects' attention. But sanitary matters are now looked upon as important; and we are all beginning to see that, although cholera and typhoid can scarcely be put down to unventilated places of assembly, yet diphtheritic and other germs as infectious and deadly, and occupying just as prominent places in our bills of mortality, may fairly be put down to that. So that, although with good ventilation by gas you may not be supplied with air as pure as that on Snowdon, yet you may reasonably be confident that in a room so ventilated you are at least respiring the very best and purest air the neighborhood can afford.

Clamp for Pulling Street Piling.

By Charles E. Emery, C.E.

[Communicated by the author at a stated meeting of the American Society of Civil Engineers.]

The trenches of the New York Steam Company vary from 4½ to 6 feet in width and from 5 to 8 and 10 feet deep. In the lower part of the city most of the soil is sandy, and although some of the fills are hard pan, the continual use of the streets and passage of heavy trucks alongside the trenches necessitate sheet piling the sides quite closely to prevent the caving of the banks. In sand or any loose material close piling is always resorted to. The piling used is spruce plank 10 feet long, 10 inches wide and 2 inches thick. It is driven down with a wooden maul, slightly in advance or closely following the excavation, according to the nature of the soil.



It was at first the practice to pull the plank as the filling was put in, but it was finally decided to allow the plank to remain in place until the fill was completed, then to pull each plank separately, sift sand in the hole, and ram it with a thin, wide tamping bar, continuing this operation until the hole was filled; then to pull the next plank and proceed as before.

During the earlier work of the Company, the foreman had constructed, for the purpose of pulling these planks, plain rectangles of bar iron, with an eye on one of the sides connecting to links with which a hook, on the pulling lever, engaged. The connecting eye being at one side, the clamp was tilted as it was lifted, so that its edges engaged with the soft wood with sufficient grip to enable the plank to be pulled. The use of this instrument, however, required that the end plank of close sheet piling be pried laterally sufficiently to admit the end of the plank, requiring some delay and occasioning not a little annoyance. To overcome this difficulty, the writer designed the clamp shown in the accompanying plate, which, as will be seen, is a mere fork of iron with interior parallel sides to fit loosely the sides of a plank and extend from one edge to nearly its entire width. The back and sides of the fork are thickened to stiffen the open jaw. An eye is forged on one of the sides, a little nearer the back than the point of the jaws, so that the heads and points nearly balance, and to this eye is connected a pair of links, as shown. A heavy wooden lever, iron bound, with hook to engage with the links, and a heavy horse to form a fulcrum, complete the outfit. In practice, the clamp is slipped on the edge of the endmost plank and the lever simply worked up and down; the clamp loosens itself and falls down as the lever is raised, and binds as the lever is depressed. Sometimes 5 or 6 men are on the lever at once to start a plank buried 6 or 8 feet in the earth.

Pyrology.

The following well-written article is from the London *Journal:*

In the course of an article upon "Furnaces," which we published a fortnight ago, some reference was made to "that department of practical science which may almost be regarded as worthy of a special name, in order to signify the art and practice of firing, stoking, furnace management, design and construction." It is our present intention to consider this idea at greater length with a view to the elucidation of its meaning. It is obvious that the combustion of fuel in some sort of furnace is one of the fundamentals of an immense number and variety of modern industries. The relative importance of the furnace to the other appliances used in the industry varies through a very wide range, from some in which it is the principal care of the manufacturer, to others in which it occupies a minor position. At the last point it vanishes in the cylinder of the gas engine.

There are few industries in which the furnace plays a more important part than in gas manufacture, although there are many others in which the application of heat to manufacturing processes is on a larger scale. The combustion of fuel for steam raising is a large division of the general subject; and the special peculiarities of steam boiler furnaces are traceable, with more or less modification, in a number of other applications. Gas retort furnaces likewise constitute a class by themselves, although closely allied to glass melting furnaces. Then there is the large class of furnaces in which the furnace proper is merged into the manufacturing plant, as in blast furnaces, cupolas, and, in a distinct subdivision, brick and lime kilns. Through all these specialized developments of the furnace there runs a continuous connection which enables us to realize that herein is a point of contact between marine and milling engineers, gas engineers, glass makers, brick burners, and iron masters—they are all interested in the study of furnaces, and in the efficient and economical combustion of fuel.

Now, there is but one kind of fuel in the world—carbon in some form, qualified very often with some hydrogen. The combustion of fuel is essentially merely the oxidation of carbon and hydrogen; and the question which all fuel users are engaged in solving, according to their

lights and opportunities, is the conduct of this process in the manner most convenient for their own special purposes. There is so much similarity in the operations of fuel utilization—the same principles are universally recognized, and at the same time the difficulties and practical requirements are so various—that we are disposed to think that the whole body of theory and practice in this matter might advantageously be regarded as a specialty, and called, say, by the distinctive name of "Pyrology."

This is not a new word, but what we suggest is a novel and specialized application of it which will not clash with any other. As a matter of fact, although the term "pyrology" is included in dictionaries as signifying the science of heat, it is never used. The only difference our suggestion makes in the meaning of the word lies in the substitution of fire for heat in the etymology, as is the case with the closely allied term, "pyrotechny." The idea of pyrology which we seek to convey is that of a science of fire in theory and practice. The theory would embrace considerations of the nature of fire, flame and incandescence as phenomena distinguished from slow oxidation. Practically the science would involve all considerations of the treatment of fire for useful purposes. The pyrologist would be the man who in the ranks of mechanical engineering thinks more of the boiler fire, while his professional brother is occupied with link motions and balanced valves. The gas manager would be a pyrologist when his desire is towards furnaces rather than purifiers or the puzzles of holder construction. Thus it may be seen that there would be pyrologists of many shades, who would yet possess much in common. In gas engineering, for example, there are men of various tendencies. Some are chemists for choice; and to these there is no pursuit in the range of their professional studies more alluring than the chase of the mysterious sulphur compounds from purifier to purifier until at last they run them home. These worthy gentlemen look upon the work of the retort house and the occasional necessity for designing new structures as evils to be endured; for to their mind the problem of gas making for the future is only that of the reduction of the last elusive trace of chemical impurity. Other gas managers, we are fain to admit, jeer at chemists as useless pedants when they are not actively mischievous troublers of the public mind, and think there is nothing in gas engineering so engrossing as the problems of dealing in the most economical way with heavy raw materials, and establishing the principles of gasholder stability. As, however, a good gas manager should be a good carbonizer to begin with, there are naturally many pyrologists among them. These are the men who have worked out the problem of generator firing for themselves, and who are not dismayed when occasion arises for changing the form of their principal fuel from solid to fluid. A good pyrologist has in him many of the makings of a good gas manager; but we would not for a moment pretend that pyrology is the only study for a student of gas manufacture.

A gas manager who is interested and expert in pyrology has affinities with pyrologists on all sides of him. He watches the progress of invention in steam boiler furnaces, with respect to which he has ideas of his own, and the practical aspect of the smoke abatement movement engages his sympathy; so that when in winter he sits beside his own blazing hearth, he can scarcely look at the fire without wondering how it could be made to burn smokelessly always. It is in regard to the great generator furnace question, however, that pyrologists of all varieties join hands. The engineer who has proved the efficacy of a gas furnace for his own special requirements usually entertains the firm conviction that the same principle can be advantageously applied to almost all purposes within the realm of pyrology. Accordingly, he remodels brick and lime kilns, and secures triumphs in applications for which gaseous firing would never have been attempted but for the successes of others. A pyrologist who has gained his experience in one school is often able to throw fresh light upon the difficulties of others differently trained; receiving assistance in kind by way of recompense. It does not matter what may be the immediate object of a new form of furnace or method of using fuel, the pyrologist will take note of it for its own sake, certain that it will turn out to be useful to him in some way if there is any real good in it. He may classify himself as a marine, a mechanical, or a gas engineer, as a lime burner, a firebrick maker, or an iron founder; it makes no difference to the interest with which he watches a device for mechanical stoking, or listens to a fresh exposition of the theory of flame.

If it were needed to illustrate the science of pyrology by citing its most prominent professor, we should name Mr. Frederick Siemens. Whoever has followed Mr. Siemens's working with fire and flame requires no better instruction as to what is comprised under the name of pyrology. There are plenty of other men eminent in this line; but, without wishing to draw invidious comparisons, or attempting to magnify Mr. Siemens at the expense of others, it is open for us to point to him as an exemplar of modern pyrology. And how infinitely has the work of pyrologists affected the development of modern industry! Very few manufactories remain in the same state as they are to be found described in the old-fashioned technical manuals, which, because they are to be had cheaply at second hand, constitute a large proportion of the libraries of engineering students who have to rely mainly upon their own resources; and nothing is more changed in most of them than the furnaces. In the iron industry alone it is known that the fuel burnt is made to perform three times the work it formerly did; and the same may be said of many other applications of fuel. All this involves the idea of a great study of the problems connected with firing, and prepares us for the discovery of a trustworthy body of accumulated experience which it is the first task of the would-be pyrologist to master, as it is the second to increase.

It would, of course, be impossible, in the space at our command, to state all, or even a part, of the canons of the special science; and unfortunately we cannot name any single book in which they may be found. There is a good deal of pyrology, of course, in all works on "Heat," and Box's well-known book, imperfect as it is, has opened this particular study to many inquiring minds. Books on mechanical engineering, and also the numerous handbooks of special industries, contain chapters devoted to pyrology; and from all these, read by the light of memoirs contributed by eminent pyrologists to learned societies, a fair elementary idea of the subject may be obtained. The true pyrologist, however, must be more than a bookman. He takes account of the phenomena presented by all furnaces, from the simplest to the most elaborate. He modifies this feature and that, with a view to a certain result, and marks the consequences, whether anticipated or incidental. The effects of hot or cold air, when admitted at different parts of a furnace, the times and conditions of feeding up, clinkering, damping down—he must know them all, and a great deal more that we cannot mention here. The glare on its own steam cloud at night from the wide-open furnace door of a passing locomotive engine is a lesson in pyrology; and if a man can fairly understand and expound it he is not far from being an adept. The deepest teachings in the science are sometimes revealed by apparently simple observations. It has long been known that a deposit of soot from a bright flame will result from putting a cold metallic surface into it; but it is only lately that it has come to be understood that a flame, whether liable to deposit carbon as soot or not, does not touch any surface without losing some of its power.

Recently intelligence of a wonderful triumph of pyrology has come from America, where it is said some genius has invented a stove which, with hardly any fuel, gets up heat enough to melt iron, and creates enough draught to propel a ship. The stove is described as having exactly the appearance of a "cast iron hat;" and it is reported to be doing such wonders that men of science are afraid to look at it lest all their acquired knowledge of combustion, etc., should be blown away, and they left shivering like naked fledgelings in a world of new experience. Where are the pyrologists of the favored neighborhood? How often has the silly story been circulated of the ignorant but heaven-born inventor who knocks down at a touch all the nonsensical science of the colleges and engineers' offices! but somehow the artless newspaper man who spreads the rumor usually sees the first and last of the untaught genius. Mr. Edward Fales, of Philadelphia, is the reputed discoverer of this new principle in pyrology; and one can only say that if the local "alleged scientists," as the *American Engineer* calls them, "are afraid to come near it," let him send one over here, where scientific observers are generally of a stouter fiber. We can promise Mr. Fales fair play, and can engage that nothing would afford us greater pleasure than the new sensation which he believes the educated people of Philadelphia cannot endure.

In pyrology, however, as in other sciences and other pursuits of men, the presumption is that what has been is that which shall be, and that the so-called new principle is simply nothing at all. We would not say, of course, that nothing new is to be looked for in pyrology. On the contrary, we hope that although principles may stand fast, novel and desirable applications may be more plentiful than ever when pyrology is recognized as a distinct science. Only a very ignorant and conceited person, however, could expect to find anything in this or any other department of human effort that will enable him to laugh in the faces of the wise and experienced men whose lives have been devoted to the science.

Messrs. Robt. B. Brandt, Michael Koenig and J. H. Kraft have incorporated the Illinois Gas Improving Company, with a capital of $150,000. The concern is to be located in Chicago, and the object is to manufacture a patented gas carburetor.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Board of Gas and Electric Light Commissioners will on Thursday next hold a hearing on the petition of the North Adams (Mass.) Gas Light Company for authority to engage in the business of generating and furnishing electricity for light and power.

T. R. POPE, who is engaged on a large scale, at Venice, Ills., in the manufacture of glucose, is fitting up a fuel gas works (capacity, 300,000 cubic feet per diem), the product from which is to be used under the boilers, etc.

OWING to a hitch in financial arrangements, work on the gas plant for Williamstown, Mass , has been temporarily suspended.

THE proprietors of the Pittsfield (Mass.) gas works have arranged for the installation of a new bed of 5's, retorts to be 14 inches by 28 inches, by 9 feet in length.

AT the annual meeting of the Reading (Pa.) Gas Company the following officers were chosen: President, Horatio Trester; Directors, David E. Stout, Chas. Brenesser, E. D. Smith, W. A. Arnold, Isaac Hiester and W. R. McIlvain.

SOME months ago a man named Mayer lost his life from contact with a "live" wire that dangled in East Broadway, this city, from a pole owned by the United States Illuminating Company. His mother brought suit against the Company—the case was tried before Judge O'Brien and a jury in the Supreme Court—and received a verdict for $2,000.

LIGHTING contractors and those interested in the construction of gas plants are asked to pay more than passing attention to the card in our advertising columns signed by the Secretary of the Brazilian Legation, Washington, D. C. The Brazilian Government is desirous of having the capital of the Province of Pernambuco lighted with gas. Beyond a doubt the concessions accompanying the grant will be far from unimportant.

AN unprincipled resident of Brooklyn recently inserted the following advertisement in a local paper: "Reduce your gas bills 75 per cent. Secret for $1." Those who forwarded the dollar received the following reply, printed in paragon type, on a dull white card: "Burn Kerosene!"

AT the first annual meeting of the Woburn (Mass.) Electric Light Company the shareholders were considerably worked up over the Treasurer's announcement that the Company made a net earning of 7 per cent. for the year, due allowance having been made for all interest charges—but nothing was charged to depreciation account. A resolution was passed increasing the capital stock from $60,000 to $120,000, and the following officers were elected: President, H. C. Buck; Clerk, B. F. Whittemore; Treasurer, F. S. Pearson; Directors, H. C. Buck, F. S. Pearson, A. E. Dolbear, J. B. McDonald and J. M. Harlow.

IT is possible that Jackson, Mich., will be called on to support another gas company. Jackson is in a bad way.

THE Pawtucket (R.I.) authorities are still struggling over the public lighting situation, the latest determination that we have information about being the following. The joint committee of Councils, according to the original resolution, was authorized to negotiate a contract with the Pawtucket Gas and Electric Light Company for such a number of electric lights as may be authorized by the City Council for a term of three years, the price per year not to exceed $140 for 2,000-candle power lamps, and $80 for half arcs (to burn one carbon per night), 300 nights to constitute a a year, the number of lights to be not less than 50 full arcs, to burn all night, and 100 half arcs to burn one carbon per night. Mr. O'Reilly moved the adoption of the motion, but Mr. Lennon thought the joint resolution should be amended so that after Jan. 1, 1890, the 50 full arcs might be changed to an equal number of half arcs, to be paid for at the rate named for lamps of that class. The amendment was adopted, and the resolution was then ratified by a unaminous vote.

THE Edison Company, of Brooklyn, N. Y., is certainly prosecuting construction work with much vigor. The excavations for the generating station on Adams and Pearl streets are on a mammoth scale, and it is asserted that the buildings and machinery will constitute a central station for incandescent electric lighting that shall exceed in magnitude and completeness any installation of this class so far reported in this country. The proprietors also seem to have carte blanche from the authorities to rip up each and any portion of the roadway that they see fit to attack, and the desultory manner in which the street campaign is prosecuted is peculiarly exasperating to the citizen, who at night is compelled to pick his way under the uncanny illumination furnished the city through the agency of the "local combine's" half-arcs. About the richest thing, however, that has been so far reported in connection with the Edison Company's distribution system is the result of a conference that was held on the 15th inst., the parties thereto being Commissioner Adams and Corporation Counsel Jenks, representing the city, and Messrs. Peabody, Packard and Doty for the Edison Company. The matter under consideration was in respect to the shifting of the underground plant of the Company, in case the city or any other corporation should in the future desire to lay pipes or wires. The outcome was an agreement that such removal or shifting shall be made, if necessary, without injury to the plant, the matter of determining who should pay the cost thereof to be left to a commission, to comprise the Mayor of the city, the President of the Edison Company and a third party to be named by the fixed members of the proposed board. Under this provision it would seem as if an independent company would have a pretty good chance to pay for the "removal or shifting" of the Edison Company's conduits.

IN response to the invitation for bids for the public lighting of East Albany, N. Y., the following propositions were received: East Albany Gas Light Company, 60 arcs (2,000-candle power), to burn from dusk to 1 A. M., on 22 nights each month, at 28 cents per light per night; Jordan Electric Company (Syracuse, N. Y.), 125 16-candle power lights for $1,995 per annum—additional lamps, $16 per annum each; 125 20-candle power lights for $2,370; same number 25-candle power lamps, $2,445. Second proposition, 30 arc lamps (1,200-candle power), $2,550; 30 arcs (2,000 candle power) for $2,850. The Council was divided on the subject of awarding a contract, and the decision was postponed.

THE Indianapolis (Ind.) authorities are debating the question whether it is wiser to maintain electric arcs in the outskirts of the city (each arc costs $81 per annum) or to favor gas lamps, which cost but $15 each per annum. Each arc is supposed to displace 4.26 gas lamps. This might be a simple riddle, unless ——.

SO FAR we understand that the Hamilton (O.) City Council has made but one appointment on the Board of Trustees to be put in charge of the construction and operation of the proposed municipal gas plant. The appointee is Mr. Herman Reutti, who is said to be in all respects competent for the position. Mr. Reutti had something to do with the construction of the Hamilton water works system.

THE gentler sex of intellectual Boston take great pride in the regular meetings of their Women's Educational Union, and the work of the latter is undoubtedly of a sort well qualified to call forth admiration. The Club, however, has appendages, also of a "progressive" nature, and one of these is the Nationalist Club, the membership whereof meet with frequency to discuss the questions of the day. At a recent session the topic for debate was the "Municipal Control of Gas Supply," Nationalist Arthur Hildreth bringing the "subject before the house" in the shape of a set paper. Now, Arthur may be a true Nationalist in many respects, but we beg leave to say that his fame as a handler of gas topics rests on a very insecure basis—provided we are to accept his ill-tempered screed on the subject noted as an index to his capacity. In fact, his presentation of the matter was such as one might look for from a man whose efforts are chiefly confined to vaporing and posturing before a feminine audience.

MR. HENRY ROACH, a local plumber, has been appointed Gas Inspector for the Toronto district, *vice* R. F. Hubertus, deceased. It was suggested that this duty should be performed by the Inspector of Weights and Measures, from whence it may be inferred that the local authorities do not hold the position of Gas Inspector as one of much value or importance. The salary certainly is not imposing in its proportions, the annual stipend being but $700.

ATLANTA, Ga., is puzzling over the fact that the price of gas is to be raised in that city to $1.50 per 1,000 cubic feet. What makes the puzzle very dense is the fact that the old Company, on a business of 70 million cubic feet per year, with gas at $1 per 1,000, was able to earn a good dividend and put by a comfortable surplus every twelvemonth, whereas the Consolidated Company—which is to employ "a much cheaper process

for making gas than that pursued by the old Company"—with a business of at least 100 million cubic feet per year, and a perfectly free field, finds it necessary to increase selling rates by 50 per cent. After all, the puzzle is not such a very difficult one. It is the old, old story of creating two capitals to accomplish the work of one, and then presuming that the investors will be indifferent as to whether or not two dividends are to be returned on the investment.

THE electric light plant of the Fremont (Neb.) Gas and Electric Light Company is of the American arc and Westinghouse incandescent type. The former has a capacity of 60 lamps, and the latter is capable of maintaining 500 lamps. At present 35 arcs are in circuit, 300 incandescents being so far taken up. The city pays for 30 gas lamps and 10 arcs. The gas department of the Company's business is widening rapidly.

AN Indianapolis plumber started out recently to find a gas leak in a house in which natural gas was used for fuel. He had as an aid a lighted match. The leak, of course, was discovered, with the following results: The plumber was killed, Mrs. Ella Kelbourn and Messrs. J T. Crowder and L. K. Farback were seriously injured, and it will cost $500 to repair the damage to building and contents.

A PARTY of Venezuelans (one a resident of New York) have filed articles incorporating the Maracaibo Lighting Company. The stated objects are to manufacture gas from coal, oil, etc., and to light by gas or electric light the city of Maracaibo, or any other city or town of the Republic of Venezuela. It is capitalized in $100,000, all of which is paid in. This place is the capitol of Zulia, and is on the west shore of the strait that connects Lake Maracaibo with the Gulf of Venezuela. It has a grand harbor, and is in fact the principal seaport of Venezuela. It is a thriving place, and its climate while hot is not unhealthy. Population about 32 000. A gas works at this point ought to prove a paying venture.

ONE of the evidences of progression in the gas business that failed to attract our attention at the time it was first offered is afforded in the action this spring of the proprietors of the Steubenville (O.) Gas Light and Coke Company, who, on April 1st, instituted the following sales schedule:

Monthly Consumption.	Gross per M.
Under 5,000 cubic feet.....	$1.50
Over 5,000 and under 10,000.....	1.35
10,000 cubic feet and over..	1.20

Even at the gross rates the charges would seem to be sufficiently reasonable, but consumers who settle their accounts on or before the 15th day of the month secure a rebate of 10 per cent. This is the policy to pursue.

A CORRESPONDENT at Menasha, Wis., under date of June 11th, writes as follows: "The Neenah and Menasha Gas and Electric Light Company yesterday extinguished the 25 street lamps that it had been maintaining without pay from the city for the past 6 months. The city is in darkness and the residents are loud in their complaints. In all the clamoring, however, I failed to detect a single protest against the Gas Company's action, which, through all the undignified squabbling indulged in by the Council in the matter of the public lighting, has been based on liberality and fairness.—WISCONSIN."

"THE annual meeting of that sterling corporation—the New Brunswick, N. J., Gas Company—disclosed the fact that gas is still in the ascendant in this commercial stronghold of Middlesex county. The shareholders are satisfied with the results, and are more than pleased with the outlook. The officers chosen were: President, Henry Richmond; Secretary and Superintendent, John W. Newell; Treasurer, James R. Palmer, Directors, A. D. Newell, M. D., and Messrs. Henry Richmond, Henry L. Janeway, Jas. R. Palmer and J. B. Kirkpatrick.—RARITAN."

INVESTORS might do well to bear in mind that the Consumers Gas Company, Toronto, Canada, will offer at auction next month 2,500 shares of new stock. The sale will take place at the rooms of Messrs. Oliver, Coate & Co., at noon of July 8. Under the Act the stock must be disposed of in 10-share lots. This is an opportunity for sound investment that is rarely available these days.

THE contest for proxies to be used at the July election of the Baltimore Consolidated Gas Company does not lose any of its point. In spite of the loud talk indulged in by the opposition to the present management there does not seem any great likelihood that the outs will carry the day. On the contrary, we know that the New York interest—and a powerful one it is—is closely wedded to the powers that be. One amusing statement recently circulated by the opposition, as a reason for the dethronement of Capt. Hall and his associates, is to the effect that the Company had but $20,000 in the treasury available for the July interest disbursements, instead of the $108,000 necessary for such purpose. If the opposition said that the Company had a surplus of $20,000 over the funds needed, they would likely have been nearer the truth.

MR. JAMES FORBES, formerly in charge at Sewickley, Pa., has been appointed Superintendent of the Chattanooga (Tenn.) Gas Company. Mr. Forbes received his first instruction in the gas maker's craft from no less a tutor than Mr. Wm. Foulis, of the Glasgow (Scotland) Corporation gas works.

ONE of the handsomest gas plants in the State of New Jersey is that owned by the Consumers Gas Company, of Woodbury.

THE new gasholder for the Alexandria (Va.) Gas Light Company will be ready by September 1st.

VICE-PRESIDENT S. M. CAREY, of the Duluth (Minn.) Gas and Water Company, is our authority for the statement that that gas plant is to be virtually reconstructed. The Meeze system of manufacture has been decided on, and it will be given a fair trial, although the Company's proprietors claim that the Meeze process has long ago emerged from the domain of experiment. Messrs. Bartlett, Hayward & Co. are under orders to construct a holder on the Company's property at Rice's Point, the capacity of the vessel to be 200,000 cubic feet.

ELSEWHERE in these columns we note that the Hamilton (O.) Council had selected Herman Reutti as a member of the local Board of Gas Trustees. Later information is to the effect that the Board was completed by the appointment of John Schwartz and Robert Allstatter. Trustee Schwartz is a baker.

IN the meantime we might also note that Messrs. N. W. Harris & Co., of Chicago, who agreed to purchase the block of bonds ($50,000) offered some weeks ago (the proceeds to go towards the construction of the Hamilton Municipal Gas Works), now refuse to take the same. They entertain doubt as to the legality of the issue.

THE Northwest Electric Light Company (Manitoba) has applied to the Provincial Government for a charter, and a contract has been made with a local firm to construct a central station (40 ft. by 80 ft.) on the Company's property at the foot of Water street. It is presumed that the distribution of electric light (arc and incandescent) will be commenced on or about September 15th. In the meantime considerable opposition to the Company has been manifested, the leader thereof being the Manitoba Electric and Gas Light Company, the attorneys for which—Messrs. Perdue and Robinson—have submitted the following protest to the Provincial Secretary:

"*To the Hon. Provincial Secretary of Manitoba, Parliament Buildings, Winnipeg*—Sir: On behalf of the Manitoba Electric and Gas Light Company, we beg to object to the issuing of letters patent incorporating the Northwest Electric Company and the Electric Light and Power Company, for the following among other reasons. The Manitoba Electric and Gas Light Company was incorporated by Acts of the Legislatures of Manitoba, being chapter 36, of 1880, chapter 38, of 1863, and chapter 35, of 1881, and this Company has been in operation for a number of years past, and has expended in and about its works in the city of Winnipeg the sum of about $450,000. The Manitoba Electric and Gas Light Company is now under a contract with the city of Winnipeg for electric lighting extending over a period of three years, and is under heavy penalties to the city of Winnipeg to keep the streets of that city lighted for 25 days in each month, from dusk until daylight. The Manitoba Electric and Gas Light Company claims that if other electric light companies are allowed to run their wires along the same streets as the Gas Company, there will be imminent danger of the wires or cables fouling each other and causing great damage to the Gas Company's wires and dynamos, and probably interrupt them in the lighting of the city, and so subject them to heavy damages. The Gas Company also claims that a charter should not be granted under the Joint Stock Companies' Act giving any company such large powers as would be involved in the granting of the two charters objected to. The two companies about to be formed will claim the right of putting up poles and posts through the

streets of Winnipeg for the purpose of their electric light, and in this way tearing up the public pavements and streets and interfering with private property. The Gas Company claims that these companies should be sent to the Legislature of the Province for incorporation, and that the large powers asked by them should not be granted under the Joint Stock Companies' Act. Upon referring to the Acts of incorporation of the Gas Company, it will be seen that it was given large powers and privileges in reference to the public streets, specially by an Act of the Legislature, and we submit these powers and privileges should not be interfered with, if at all, by anything less than an Act of the Legislature, and that charters under the Joint Stock Companies' Act should not be granted in the case of the companies objected to."

"NORFOLK, VA., June 15, 1889.

"To the Editor AMERICAN GAS LIGHT JOURNAL:—'Died, 7 A.M., June 9, at his residence, No. 57 Charlotte street, Norfolk, Va., Joseph H. Dawson, Secretary City Gas Light Company.' Such was the brief announcement conveying to many of his friends and business associates the first intelligence of the passing away of a true Christian, a loving husband and father, a faithful officer, and a modest and unassuming but valued citizen of this community.

"'Brother Dawson,' as he was called by nine-tenths of his acquaintances, was during life so opposed to outward display of his virtues that, in deference to this marked trait of his character, I will but briefly notice his career as known to his associates of the gas fraternity.

"Deceased was born in Baltimore, Md., Mar. 12, 1823, and moved to Petersburgh, Va., Dec. 5, 1841, and to Norfolk in 1842. He engaged here in business with fair success, and, in 1860, entered the service of the Norfolk City Gas Light Company, as its Secretary. This position he held almost continuously up to the day of his death; the interim being the period when the Federal Government took charge of the works. During this period of nearly 30 years his management of the business pertaining to his position was as true to the best interests of his Company 'as the needle to the pole;' and from personal experience I can say that in few gas offices in the country was there less friction in the routine of business than in his. Aside from being a strictly methodical man, Brother Dawson was also a consistent, almost life long Christian, having joined the Methodist-Episcopal Church in 1841; and there are few men in this or any other city whose conduct through life so nearly accords with profession as did his.

"His family have lost a loving head and counsellor, the Gas Company a faithful and conscientious officer, and the community a citizen whose life could be emulated to its lasting benefit. Truly yours,

"T. A. BATES."

THE Norfolk City Company, in consonance with sound business principles, has advanced Mr. Wm. N. Grubb, who had been Assistant Secretary, to the position of Secretary.

MR. BAXTER is having a busy time of it this summer at his post in the Detroit (Mich.) works. The betterments underway comprise a 600,000 cu. ft. holder, the contract for which was awarded to Messrs. Morris, Tasker & Co. The holder is to be covered in a brick house, not pierced for windows; ventilator openings, however, are numerous. The roof is composed of alternate sections of slate and glass. In the retort house 4 benches of 6's are to be placed. The retorts are "throughs," 21 feet long, the lower vessels being 16 in. by 28 in., the upper ones being 17 in. by 30 in. The hydraulic main is 28 inches, and is furnished in independent section to each bench. Only one hydraulic is employed, the gas being so taken from the "through." The stand-pipes are 8 inches in diameter. The iron work for benches is from the Bouton foundry, and the firebrick material is furnished by the Laclede Company. Mr. Baxter will also put down one mile of 16 inch main.

ON June 15th the Edison United Manufacturing Company, of this city, through its attorney, Fremont Timberlake, filed a petition praying that the Farmington, Me., Electric Light and Power Company be declared insolvent. The hearing will take place on Wednesday. The Company has been running steadily behind for some months. In fact, it was a failure from the start.

The electric light plant at Newton, Kansas, was destroyed by fire on the morning of the 12th instant.

THE Committee on Finance and Electric Light, of the Richmond, Va., Councils, have reported that it is inexpedient at this time for the city to purchase and operate an electric lighting plant on municipal account.

AN Exchange says that John R. Truesdale and Robt. Foster vs. L. K. Scofield, Peter Bauer and James Daniels and the Fort Scott Gas Company is the title of a suit filed last week in St. Louis, by Messrs. Lodge and Talty. John R. Truesdale is a gas works builder of that city, and Robert M. Foster is an attorney there. In their petition they allege that L. K. Scofield holds $125,000 of the $150,000 worth of stock for which the Fort Scott Gas Company is capitalized, and that he agreed to dispose of his interest to them. As there was some doubt as to the value of the stock, owing to the plant being out of repair, etc., it was agreed, so the petitioners allege, that each party should appoint a disinterested man to appraise the plant, and that their decision should decide the price to be paid. Scofield selected Peter Bauer, and Truesdale and Foster named James Daniels. The former appraiser valued the plant at $80,000, and Daniels put its value at $38,000, and they could not agree as to what is the real value of the plant. It is alleged by the petitioners that Bauer is not a disinterested party, and that he includes in his estimate the Company's charter, which, it is claimed, expired last March, and its contracts, which the plaintiffs allege do not exist. They claim the Company is furnishing gas to the city of Fort Scott from month to month, and is liable to be shut out from the lighting at any moment. There is a new corporation there owned by Pittsburg (Kan.) parties which, it is claimed, has a charter to use the streets and furnish gas. The petitioners allege that since offering to sell them the plant, Scofield has received a better offer from Eastern parties, who intend to issue $150,000 worth of bonds on the plant, and the plaintiffs ask that Scofield and the Company be restrained from transferring any of their stock or floating bonds, and that the appraisers appointed be instructed in their duties, and to select a third party to confer with them as to the value of the plant, the vote of two of the three fixing the purchase price. It is supposed that Truesdale and Foster represent the new Gas Company at Fort Scott, owned by the Pittsburg (Kan.) people, and that the purchase is for the purpose of absorbing the Scofield Company. The Court is also asked to decide whether the charter of the Fort Scott Gas Company has not expired.

Retailing Electric Light through Meters in Glasgow.

While the citizens of London, and of some of the provincial towns in England have been enabled for some time now to light premises, however small, by electricity from a common source, it is only now that the opportunity has been offered to the people of Glasgow by a small company formed for the purpose. New works have been fitted up in a central part of Glasgow, the ground floor having an area of 1,400 feet, and everything is so arranged that the generating power may be supplemented should the demand necessitate it. The plant is worked by a compound engine, with cylinders 14 in. and 22 in. in diameter, with a stroke of 42 in. Steam is provided by a locomotive boiler of steel, working to a pressure of 100 lbs. to the square inch. At this pressure the engines indicate 200-horse power while making 85 revolutions per minute, and an auxiliary engine is provided capable of developing 50 indicated horse power. The main dynamo is the largest in Scotland. The diameter of the armature is 4 feet, and it runs at about 450 revolutions per minute.

It is constructed to supply 3,000 lamps of 8 candle power. The "transformer" system of distribution is adopted, and it is so arranged that the current can be transmitted 5 miles, which would embrace the whole of the city. Six overhead circuits are provided. The present plant may supply 3,500 incandescent lamps; and by next winter the company expects to have in operation another engine and dynamo for doubling the generating power.

Messrs. Muir, Mavor and Coulson, the contractors, have had for several years a station worked on the direct current system, and it is retained, and supplies several establishments with electric light, including the general post office and the offices of the Telephone Company.

The installation in the municipal buildings is the most important arranged. In the building there are over 1,100 lights of 16-candle power. The high-pressure wires are carried into two of the corner turrets in the building, where they are connected with six transformers. The meter for measuring the electricity is also placed here. It consists of two clocks placed side by side, and when the current is turned on the movements of one pendulum are accelerated in proportion to the power of the current, and by this means a record is made on the dial, as in the gas meter. Thence the current passes to the switchboards, from which the lights are separately controlled. A current indicator for checking the meter may be attached to the switchboard.

The current costs the user 15.7 cents per 1,000 watt hours, a sliding scale being allowed, according to the quantity consumed; but after all the price will be about double that of gas, which is 67 cents per 1,000 cubic feet in Glasgow.

The Market for Gas Securities.

Consolidated this week sold down to 87¼, which is something like 5 points below the quotations at the time the dividend was declared. There is no cause for such shrinkage, and we would strongly urge its purchase at the ruling rate. To-day (noon, June 21) the bid price is 87⅝. Mutual holds its recent advance, and Equitable enjoys a like standing. Brooklyn shares are held at advancing figures, Williamsburgh and old Brooklyn taking the lead.

There is not much to note in connection with out-of town shares, although the tendency is all towards better figures. An inquiry for Jersey City gas sent these shares up with a rush, and holders are now asking 179 for what they would have parted with a fortnight ago at 170. The bid figure is 173. The time for accepting the bid of the Troy syndicate for old Troy Company's shares having expired, the Manufacturer's Bank reports that of the 3,000 shares capital only 60 remain in independent hands. Chicago Trusts have manifested weakness, and the range in values has been large. The ruling bid is 59.

Baltimore Consolidated remains about as before, and the canvass for proxies to be used at the coming July meeting is still going on. The output of the Company for the year ended June 1st is said to have been close to 1,150 million cubic feet, which means, say, a profit of $690,000. The interest charges are $384,000. From this it would seem that the common stock is a purchase at present prices—45 to 47, for it is reasonable to suppose that by 1891 the stock will be earning a 4 per cent. dividend. Messrs. N. W. Harris & Co., of Chicago, have refused to take the bond issue purchased at auction by them from the city of Hamilton, O. They assert that under the Ohio laws the municipality cannot operate a gas works. The First National Bank of Hamilton, however, stands ready to take the securities.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 Wall St., New York City.

June 24.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	87⅜	—
Central	500,000	50	—	—
" Scrip	220,000	—	—	—
Equitable	4,000,000	100	125	—
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	116	118
Mutual	3,500,000	100	105	106
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	60	70
" Bonds	15,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	106	—
Citizens	1,200,000	20	67	70
" S. F. Bonds	320,000	1000	—	103
Fulton Municipal	3,000,000	100	125	128
" Bonds	300,000		—	106
Peoples	1,000,000	10	72	75
" Bonds (5's)	368,000	—	97	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	89	—
Nassau	1,000,000	25	111	—
" Ctfs	700,000	1000	100	103
Williamsburgh	1,000,000	50	121	125
" Bonds	1,000,000	—	109	112

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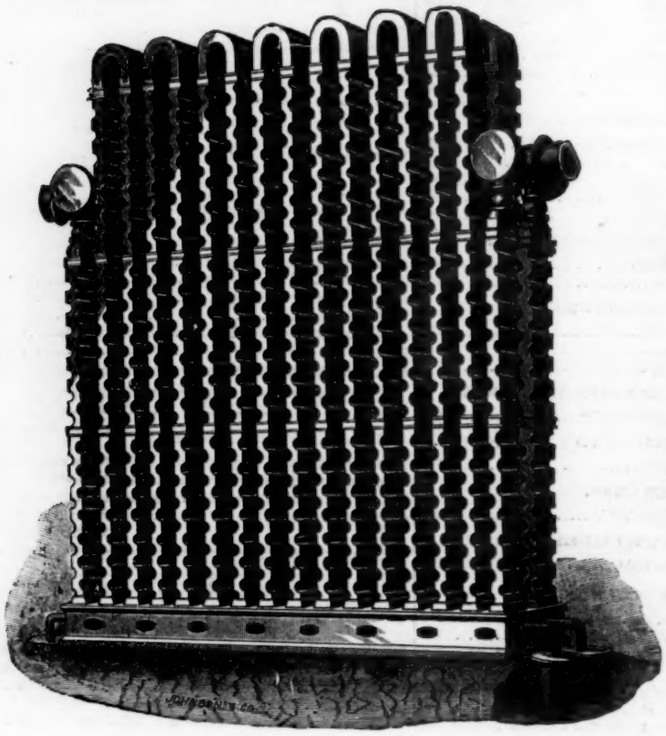

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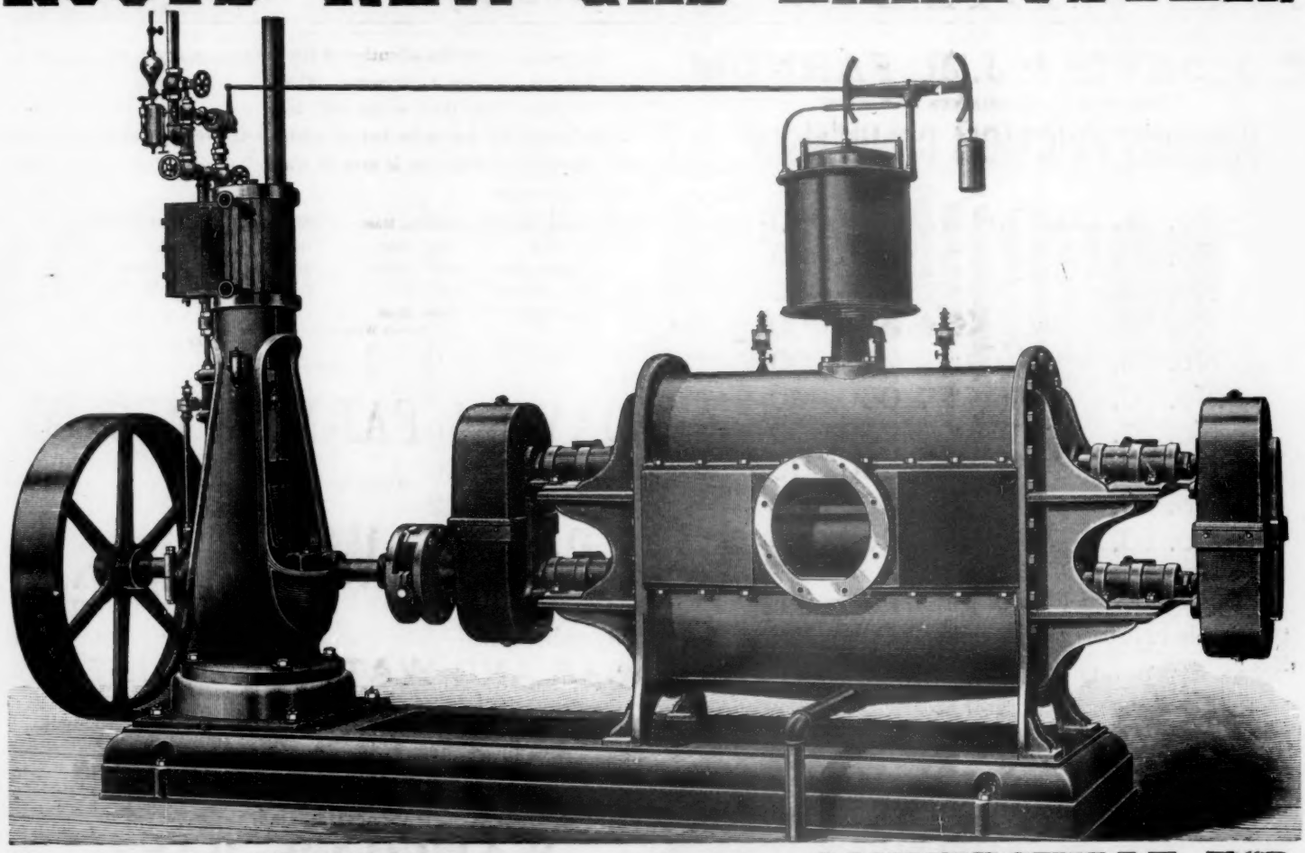

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The following Engineers have personally given permission to refer to them:

G. C. Trewby, Esq., Engineer-in-Chief of the Gas Light and Coke Co., London. The manufacturing plant at Beckton is built in complete sections of 3,000,000 cubic feet capacity each. A Walker Tar Extractor has been fitted to each one of these sections. This was done after a long and thorough trial on one of its sections. The Tar Extractor has been supplied to other works of the Gas Light and Coke Co., including those of which John Methven, Engineer of the Gas Light and Coke Co. at the Nine Elms Station, is in charge. Also to G. E. Stevenson, Peterborough Gas Works; B. Green, Mitcham and Wimbledon Gas Works; W. H. Smith, Bedford Gas Works; F. Linging, Norwich Gas Works; J. T. Browning, Colchester Gas Works; S. B. Darwin, Portsmouth Gas Works; J. McCrae, Dundee Gas Works; W. J. Wells, Stamford Gas Works; J. M. Darwin, Longton Gas Works; J. Paterson, Warrington Gas Works; and J. Coulter, of the Dundalk Gas Works. All of the foregoing gas works are located in Great Britain.

Mr. Charles A. Gerdenier, Superintendent of the Bridgeport (Conn.) Gas Light Company, writes as follows, under date of Dec. 3, 1887:

"The C. & W. Walker Tar and Carbonic Acid Extractor has been in operation at these works for the past six weeks, and is an unqualified success. It removes every particle of Tar from the gas in once passing through the apparatus, and a large percentage of the Carbonic Acid. I also feel quite sure that it prevents the formation and deposit of Naphthaline, because since I started the Washer I have had no stoppages from this cause. These works have been seriously troubled with Tar for many years, and I have used several kinds of apparatus and every expedient which has come to my attention for dealing with the difficulty, but without success. The Walker apparatus occupies comparatively small space, is less expensive than other systems, and requires but little attention. I carry 2½-inch seal, and have an automatic tar delivery valve. This Tar Extractor is indispensable to gas makers."

I have taken the Agency for the United States for this apparatus, and am now prepared to make contracts to erect it on the premises of any Gas Company. It would be manufactured in the following sizes:

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No. 3,	"	"	250,000	"	"	"	5	"	"	"	"
No. 4,	"	"	500,000	"	"	"	6	"	"	"	"
No. 5,	"	"	750,000	"	"	"	7	"	"	"	"
No. 6,	"	"	1,000,000	"	"	"	8	"	"	"	"
No. 7,	"	"	1,250,000	"	"	"	9	"	"	"	"
No. 8,	"	"	1,500,000	"	"	"	10	"	"	"	"
No. 9,	"	"	2,000,000	"	"	"	12	"	"	"	"
No. 10,	"	"	3,000,000	"	"	"	15	"	"	"	"

This Tar Extractor will perform its work with about one-fourth the usual back-pressure heretofore required. It is simple in construction, and can be supplied at a very reasonable price—less than any other ever before introduced. Satisfactory results will be guaranteed in every instance.

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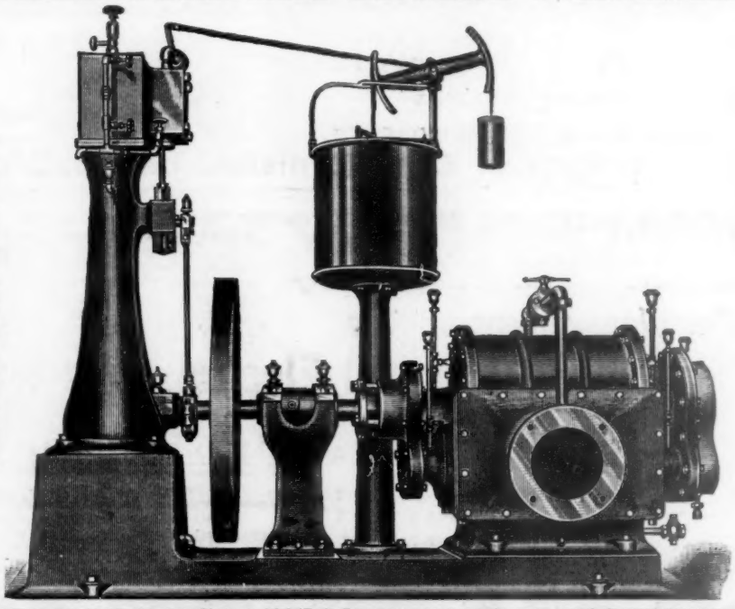

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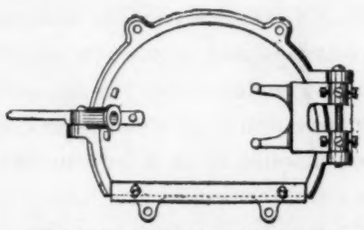

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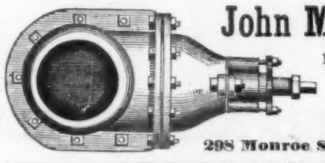

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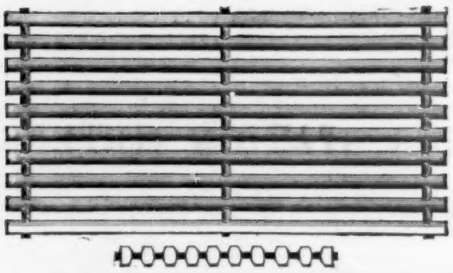

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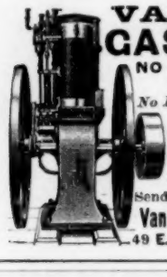

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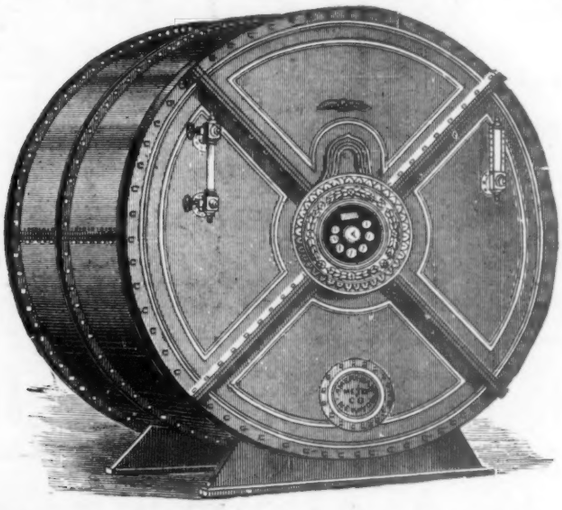

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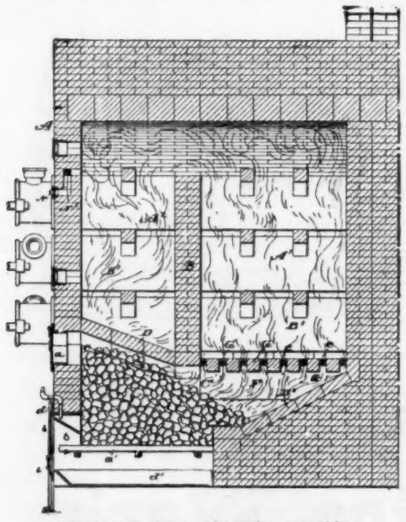

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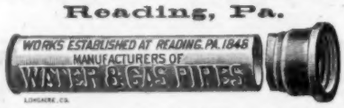

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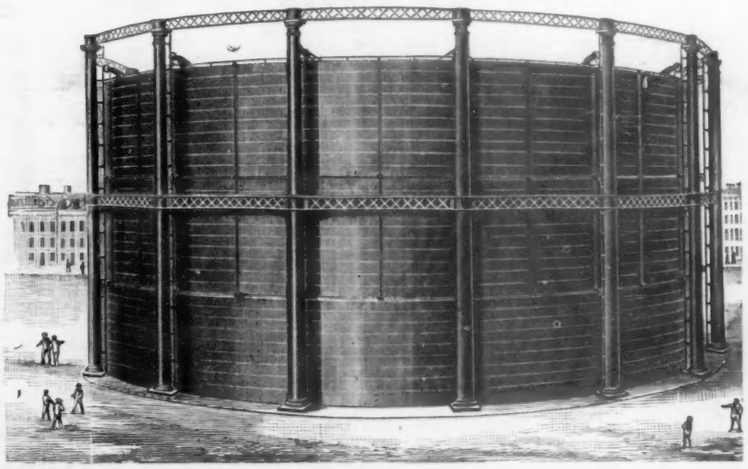

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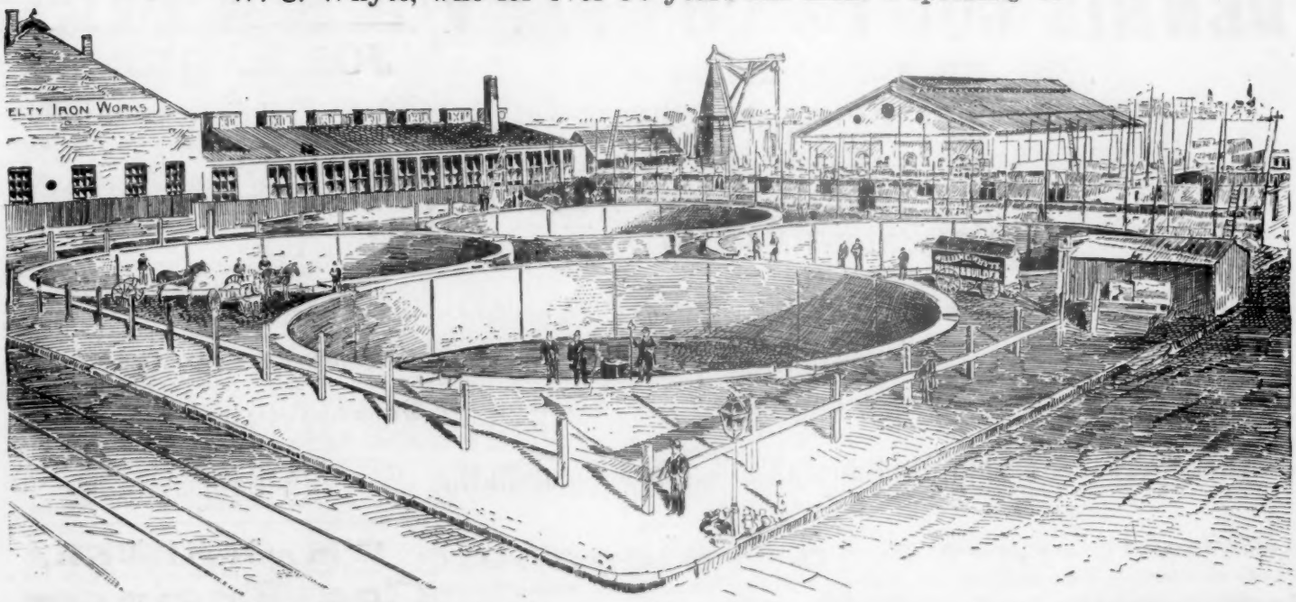

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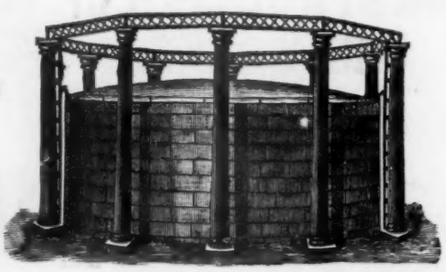

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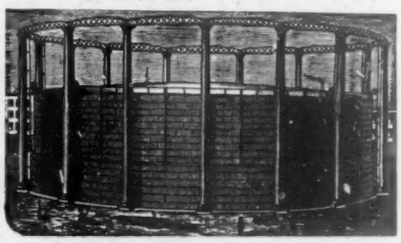
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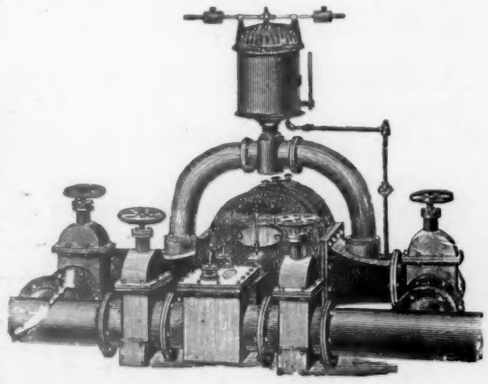

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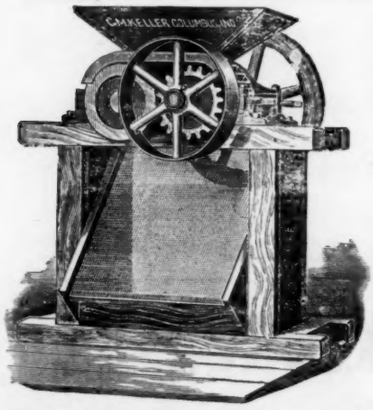

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20 in. wide.	17½ in. wide.	18 in. wide.	21 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has four burners on top, and double oven burner.

Consumption of gas with all burners in use, 42 feet per hour, at 1 inch pressure.

The top is made in sections, so that a greater variety of cooking utensils may be used. By lifting out the covers and crosspieces and putting in a suitable forked ring, which is sent with each stove, a wash boiler or other large utensil may be set over two burners. Our **No. 87 GRIDDLE** also fits in the same position. The roasting oven is provided with a cast-iron door.

All Fittings are Nickel-Plated.

GAS COOKING STOVE, No. 7 B.

SIZE.

Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves,
31 in. high.	9½ in. high.	10 in. high.	21 in. long.	32 in.
17 in. wide.	14½ in. wide.	15 in. wide.	16 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has three boiling burners in the Top or Hot Plate, and one single oven burner.

This cut represents our New Style Cooking Stove. As will be seen, it has an ornamented cast-iron Base and Front, and extension shelves. The Oven Burner, which is atmospheric (unless otherwise ordered), is of an entirely new and improved pattern (patent). The ovens are of greater capacity than those of the old style. The Top, in conjunction with the Outlet Pipe, is designed to carry off all the products of combustion, if desired, but they are also supplied with a loose ring which converts it into an ordinary open top stove.

The consumption of this Stove is 35 cubic feet per hour at 1 inch pressure, with all Burners in use.

All Fittings are Nickel-Plated.

"RADIANT" BOILING STOVE, WITH REGENERATIVE BURNER.

Size, 6½ inches diameter, 8 inches high. Consumption, 6 feet per hour at 1 in. pressure.

HOT PLATE, No. 111.

Size, 36 in. long, 12 in. wide, with three double burners, 6 taps.

Consumption, with all burners in use, 36 cubic feet per hour, with 1 in. pressure.

¾ in. supply pipe should be used where the pressure is 1 in. or over.